2.7

Response Action Contract

Contract No. 68-W-98-228

United States
Environmental Protection
Agency

REGION 10

Final (Revision 2)

REMEDIAL INVESTIGATION REPORT

Coeur d'Alene Basin
Remedial Investigation/Feasibility Study

VOLUME 2
Part 2

September 2001

URS Greiner
in association with
CH2M HILL
White Shield, Inc.

CSM Unit 1, Upper Watersheds

Canyon Creek

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ABBREVIATIONS AND ACRONYMS

AWQC	Ambient Water Quality Criteria
bgs	below ground surface
BLM	Bureau of Land Management
CCSeg	Canyon Creek segment
cfs	cubic foot per second
COPC	chemical of potential concern
CSM	conceptual site model
EPA	U.S. Environmental Protection Agency
EV	expected value
$FeCO_3$	siderite
FeS_2	pyrite
FIS	flood insurance study
FS	feasibility study
gpd	gallon per day
gpm	gallon per minute
IDEQ	Idaho Division of Environmental Quality
MFG	McCulley, Frick & Gilman, Inc.
µg/L	microgram per liter
mg/L	milligram per liter
msl	mean sea level
PbS	galena
PDF	probability density function
PRG	preliminary remediation goal
PVC	polyvinyl chloride
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
SL	screening level
South Fork	South Fork Coeur d'Alene River
SVNRT	Silver Valley Natural Resources Trustees
TMDL	total maximum daily load
URS	URS Consultants, Inc.
URSG	URS Greiner, Inc.
USACE	U.S. Army Corps of Engineers
U.S.D.A.	U.S. Department of Agriculture
USGS	U.S. Geological Survey

ABBREVIATIONS AND ACRONYMS (Continued)

WRCC	Western Regional Climate Center

1.0 INTRODUCTION

The Canyon Creek Watershed is located within the Coeur d'Alene River basin and is a southwest-flowing tributary of the South Fork Coeur d'Alene River (South Fork). The Bureau of Land Management (BLM) has identified 125 source areas (e.g., mining waste rock dumps, adits, and jig tailings piles) (Table 4.1-2) within the watershed (BLM 1999). The watershed has been affected by mining activities and hazardous substances have been and continue to be released into the environment.

There have been several previous clean-up activities in the Canyon Creek watershed. During the 1997 and 1998 field seasons, the Silver Valley Natural Resources Trustees performed several removal actions for the Frisco and Gem mill sites, the Standard Mammoth Facility, the Black Bear Fraction and Flynn Mines and the Canyon Silver (Formosa) mine and mill sites. In addition, contaminated tailings and sediment were also removed from the Canyon Creek channel and impacted riparian zone from the Gem mill site downstream to Woodland Park. Soils at removal areas were amended with organic materials and revegetated; the stream was stabilized using bioengineering methods (Harvey 2000). With the exception of grasses in some areas, other vegetation (trees and shrubs) was not successful. An unlined repository was constructed at Woodland Park to contain the estimated 600,000 cubic yards of material yielded by these removals. This repository was capped with growth media and revegetated (Harvey 2000). Recent monitoring by USGS indicates a plume of metals contaminated groundwater down-gradient from this repository (Box 1999).

One of the Mining Companies is presently installing a passive-treatment pilot on top of the Star Tailings Pond. In the 2000 field season, a 1.25-mile long, 8-inch diameter pipeline from the Gem Portal to the Star Pond was installed. The 10 gallon-per-minute pilot is designed to treat a portion of the Gem discharge using two parallel treatment trains: one with a vertical filtration cell and high permeability bioreactor, and the other with vertical filtration and low permeability bioreactor. The pilot will be used to help assess the effectiveness of these methods in effectively treating acid mine drainage. Implementation is expected to occur in the 2001 field season (Hansen 2000).

Several actions have also been implemented to address human health concerns in this watershed. During the 1997, 1998, and 1999 field seasons, the USACE on behalf of the USEPA has performed several residential soil cleanups determined to be necessary to protect human health. These actions include removals at 10 residential properties within the Canyon Creek watershed.

In addition, one home was placed on an end-of-tap water purification system, as their water did not meet the Removal Action Level for drinking water (USEPA 1999, 2000a, and 2000b).

This watershed is one of eight watersheds assigned to conceptual site model (CSM) Unit 1, Upper Watersheds (see Part 1, Section 2, Conceptual Site Model Summary). The watershed itself has been divided into five segments to focus this investigation (Figure 1.1-1). The following section provides a brief description of each segment.

1.1 SEGMENT DESCRIPTIONS

Segment 1 contains the headwaters of Canyon Creek downstream to just above the Ajax No. 3 Mine (Figure 4.1-1). The BLM identified19 mining-related sites (source areas of potential metals contamination) in this segment; however, Canyon Creek does not receive significant metals input from this segment. The area is relatively undisturbed with an intact and well-vegetated riparian zone and stable stream banks.

Segment 2 starts just above the Ajax No. 3 mine and continues downstream to the mouth of Gorge Gulch at Burke (Figure 4.1-2). The BLM identified 13 source areas in this segment; however, this segment of Canyon Creek has relatively low concentrations of metals and does not contribute significantly to metals loading to the Coeur d'Alene River system. The area is relatively undisturbed, with an intact and well-vegetated riparian zone and stable stream banks.

Segment 3 contains Gorge Gulch, where mining-related impacts are first noted with increased metal concentrations in surface water (Figure 4.1-5). The BLM identified 17 source areas in this segment. Sampling of surface water indicates that metals concentrations are greater than ambient water quality criteria (AWQC).

Segment 4 begins at the mouth of Gorge Gulch and ends near the West Bell Mine, south of Gem (Figure 4.1-8). The BLM identified 64 source areas in this segment. Sampling of surface water indicates that metals concentrations in surface water are greater than AWQC. Aquatic life in this part of the watershed is nearly absent. Channelization is extreme in this segment. Upstream at the Hecla-Star Mine and millsite, the stream enters an approximately ½-mile-long box culvert, and then emerges to a tightly constrained channel. There has been extensive modification of the stream bank in the lower reaches of this segment in conjunction with historical mining-related activities; residential, industrial, and transportation infrastructure development; mine tailings recovery; and remediation.

Segment 5 begins near the West Bell Mine, south of Gem and ends at the confluence of Canyon Creek and the South Fork Coeur d'Alene River (Figure 4.1-11). The BLM identified 12 source areas in this segment. Sampling of surface water indicates that metals concentrations in surface water are greater than AWQC. Aquatic life in this part of the watershed is nearly absent. In the lower half of the segment, the valley broadens. A wide flowing river is present with up to 40 feet or more of alluvium above the bedrock. A former tailings dam was maintained at Woodland Park until the dam failed because of floods in 1917. Tailings deposits from the floodplain in this segment have been excavated and placed in a new repository on the south side of the stream. Sampling conducted during the remedial investigation suggests that floodplain sediments remain affected by high metals concentrations.

1.2 REPORT ORGANIZATION

The remedial investigation report is divided into seven parts. Part 2 presents the remedial investigation (RI) results for the eight CSM Unit 1 upper watersheds. This report on the Canyon Creek Watershed is one of eight reports contained within Part 2. The content and organization of this report are based on the U.S. Environmental Protection Agency's (EPA) *Guidance Document for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final* (USEPA 1988). This RI report contains the following sections:

- Section 2—Physical Setting: includes discussions on the watershed's geology, hydrogeology, and surface water hydrology
- Section 3—Sediment Transport Processes
- Section 4—Nature and Extent of Contamination: includes a summary of chemical results and estimates of mass loading from source areas
- Section 5—Fate and Transport: includes chemical and physical transport processes for metals
- Section 6—References

Risk evaluations and potential remedial actions associated with source and depositional areas are described in the human health risk assessment, the ecological risk assessment, and the feasibility study (all under separate cover).

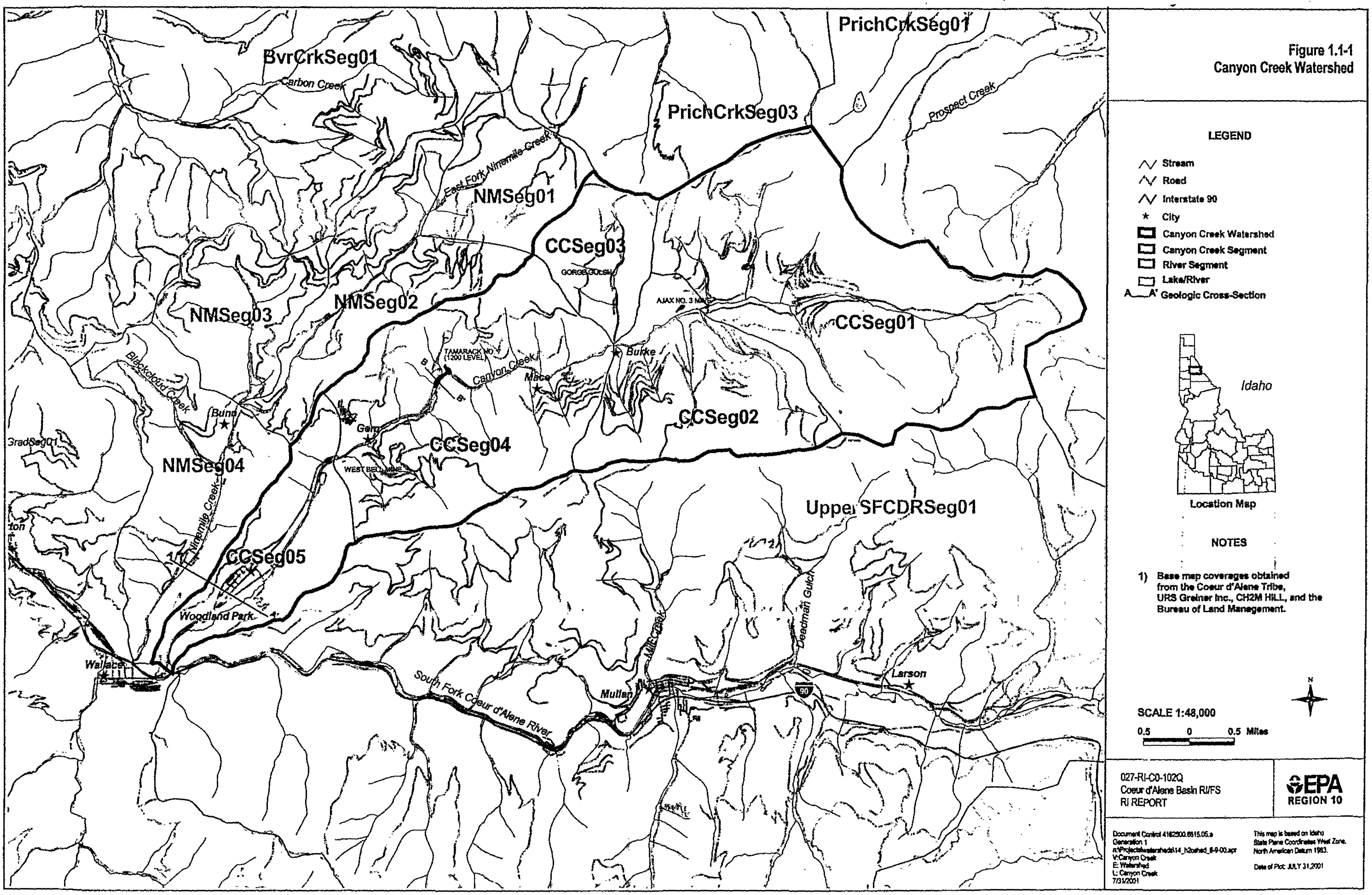


Figure 1.1-1
Canyon Creek Watershed

2.0 PHYSICAL SETTING

This section presents a discussion of the geology, ore deposits, mining history, hydrogeology, and hydrology of the Canyon Creek Watershed.

2.1 GEOLOGY AND MINES

The Canyon Creek Watershed is a steep-walled, deeply incised canyon. The locations of two geologic cross sections are shown in Figure 1.1-1; the two cross sections are provided in Figures 2.1-1 and 2.1-2. The steep topography of the Canyon Creek Watershed and the presence of Quaternary alluvium and tailings atop sedimentary bedrock are shown in both cross sections and discussed below. Figure 2.1-1 shows the position of the Hecla-Star Tailings Ponds and a tailings repository relative to the Quaternary alluvium, channel and terrace gravels. Mining history in the watershed is presented in Section 2.1.6.

2.1.1 Geomorphic Setting

The Canyon Creek Watershed begins at the Bitterroot Divide which separates the Clark Fork Basin from the Coeur d'Alene Basin. Canyon Creek flows in a westerly direction and empties into the South Fork at Wallace (Part 1, Figure 1.2-2). The Creek is characterized by a high stream gradient within a deeply incised, V-shaped canyon in its upper reaches. In the vicinity of Woodland Park, the gradient decreases, and Canyon Creek opens into a U-shaped canyon. Where Canyon Creek flows into the South Fork at Wallace, and west of Wallace, the South Fork flows through a U-shaped canyon.

2.1.2 Bedrock Geology

Sedimentary rocks assigned to the Precambrian Belt Supergroup are the dominant rocks in the Canyon Creek Watershed (Part 1, Figure 3.2-2). Two formations within the Precambrian-age Belt Supergroup that predominate are the Prichard and to a lesser degree the Burke Formation of the Ravalli Group. The Prichard consists of argillite, quartz-rich argillite, and quartzite, whereas the Burke Formation consists of impure to lesser pure quartzite.

In the upper reaches of the watershed, there are lesser amounts of the Revett and St. Regis Formations of the Ravalli Group; both the Revett and Regis overlie (and are younger than) the Prichard and Burke Formations. The Revett is impure to pure quartzite, and the St. Regis is more variable and consists of either argillite, quartzite, or carbonate-bearing (limestone or limestone-rich) beds (Part 1, Figure 3.2-2).

The Cretaceous-age Gem stocks outcrop on the north side of Canyon Creek between Wallace and Burke (Part 1, Figure 3.2-2). The Gem stocks are igneous monzonite, a granite-type rock, that is younger and intrudes (i.e., is welled up within) the older Belt Supergroup rocks.

2.1.3 Structural Geology

The Canyon Creek Watershed exhibits two dominant structural trends defined by north-northwest-trending faults and roughly east-west-trending faults (Part 1, Figure 3.2-2). The faults are both normal and reverse faults, with dip-slip movement involving hundreds of feet of displacement and strike-slip movement of up to 16 miles (as seen on the east-west trending Osburn Fault). The north-northwest-trending faults are more prevalent in the upper portion of the Canyon Creek Watershed, whereas the east-west faults (e.g., Golconda, Paymaster, and Wonder Faults) in the topographically lower areas are roughly parallel with the Osburn Fault (Part 1, Figure 3.2-2).

The sedimentary Belt Supergroup rocks are moderately folded throughout the watershed, and the fold axes typically trend in a northerly direction.

2.1.4 Soils

Like most of the soils throughout the Coeur d'Alene district, the soils in the Canyon Creek Watershed can be grouped into two broad categories: hillside soils and valley soils. Hillside soils typically consist of a silty loam with variable amounts of gravels and clay. Hillside soils are generally less than 2 feet thick. Valley soils are found within the streams of Canyon Creek and the floodplain (Part 1, Figure 3.2-2).

Valley soils can be further subdivided into two types: (1) Quaternary glacial and glaciofluvial deposits (Part 1, Figure 3.2-2, symbol Qg) located in the headwaters of Canyon Creek, and (2) Quaternary alluvium (Part 1, Figure 3.2-2, symbol Qal), which is unconsolidated material and occurs throughout most of the length of Canyon Creek. Included with the Quaternary alluvium are tailings and related materials produced by mining activities. Tailings are discussed further in Section 4, Nature and Extent of Contamination.

The metal concentrations in soils may be greater where underlain by near surface mineralized rock (ore deposits). Elevated metal concentrations in soils overlying near surface ore deposits (dispersion patterns) have been studied in the district (Gott and Cathrall 1980). This is an important concept for evaluating pre-mining background metal concentrations in the district. Therefore, dispersion patterns were accounted for in background ranges of metals in soil presented in Part 1, Section 5.2.

Various geotechnical analyses were performed on materials obtained from the upper Star Tailings Ponds in segment CCSeg05, including grain size analyses, hydrometer tests, Atterberg limits, moisture-density relationship, consolidation tests, direct shear, and triaxial compression. These analyses were performed for the Mine Owner-initiated pilot project studying the performance of a passive treatment system for the Gem Portal mine drainage (MFG 1999, 2000).

2.1.5 Ore Deposits

Canyon Creek drains the Golconda-Lucky Friday, Gem-Gold Hunter, Rex-Snowstorm, and Tamarack-Marsh mineral belts (Part 1, Figure 3.2-3). At least 21 mines and mining complexes have operated in the Canyon Creek Watershed. More ore was produced from mines in the Canyon Creek Watershed than in any other watershed in the district. The largest producing mines were the Star-Morning, Hecla, Standard-Mammoth, Hercules, Helena-Frisco Group (which includes Black Bear, Frisco, and Gem), Tamarack, and Tiger-Poorman (Table 2.1-1). A summary of mines located in the canyon is presented in Section 2.1.6. Mine locations are shown on figures in Section 4.

As indicated by the production figures, lead and zinc were the most abundant metals produced. The Canyon Creek Watershed hosts what is referred to as lead-zinc replacement deposits, where ore-bearing fluids altered the host quartzites and argillites by replacing the quartz and clay minerals with sphalerite and galena. Waste rock piles are present at most mine workings in the Canyon Creek Watershed. Waste rock consists of broken, angular rock that is generally unmilled and typically dumped near the mouth of the mine workings (Box, Bookstrom, and Kelley 1999). Most of the larger waste rock piles in the watershed are located upstream of the town of Gem. The metal content of waste rock is discussed in Section 4, Nature and Extent of Contamination.

In general, most of the ore deposits associated with the Canyon Creek Watershed occur at the transition between the Burke and Prichard Formations (see Figure 2.1-2, Standard-Mammoth Mine and Tiger-Poorman Mine). Within these two formations, most of the deposits occur within quartzite strata (Umpleby and Jones 1923). For example, the Helena-Frisco, Standard-Mammoth, Tiger-Poorman, and Hecla are all within (or predominantly within) the Burke Formation quartzite (Part 1, Figure 3.2-2). The largest mine in the watershed, the Morning-Star, is also in quartzite, although it is assigned to the Revett Formation.

Quartz and siderite, an iron carbonate ($FeCO_3$), are the most common non-ore minerals associated with the deposits. In some deposits in the Canyon Creek Watershed, siderite is more abundant than quartz, and in others, siderite is absent (Ransome and Calkins 1908).

2.1.6 Mining History

A brief summary of available information on historical mining activities is presented in this section. During the RI/FS process, an extensive list of mines, mills, and other source areas was developed based on a list originally developed by the Bureau of Land Management (BLM 1999). This list is presented in Section 4.1, Nature and Extent, and in Appendix I.

Mining in the Canyon Creek Watershed began in 1887 and continued until 1991. Silver-lead ore, and later zinc, was extracted from subsurface deposits. Mills were constructed along Canyon Creek to concentrate the ore before its shipment to smelters. The concentration process required large volumes of water and resulted in the generation of fine dust and tailings. Locating mills along the creek provided the water needed to operate the mills and a convenient disposal method for the tailings produced by the concentration process. Prior to 1965, all of the mills along Canyon Creek discharged most, if not all, of their tailings to the stream. In 1965, the Star Mine constructed tailings ponds in the Canyon Creek floodplain upstream of Woodland Park. By 1968, all the mills impounded their tailings (Stratus 1999). Figures in Section 4 show the location of some of the mines and mills that historically operated in the Canyon Creek Watershed.

Between 1887 and 1990, at least 21 mines and mining complexes in the Canyon Creek produced an estimated 36 million tons of ore (Mitchell and Bennett 1983a, SAIC 1993a). From this ore, an estimated 2.6 million tons of lead, 1.2 million tons of zinc, 9,000 tons of copper, 5,000 tons of silver, 1 ton of gold, and 27 million tons of tailings were produced (Mitchell and Bennett 1983a; SAIC 1993a). The following sections summarize the mine and mills operated in the Canyon Creek Watershed.

2.1.6.1 Mines

The mines that operated in the Canyon Creek Watershed for which ore production was recorded are listed in Table 2.1-1. This table includes the production years of the mine, estimated volumes of ore and tailings produced as a result of the mining activity, and the segment in which the mine is located. Not all of the mines operating in the watershed are listed because ore production, if any, has not been documented for every mine. Additionally, some mining operations were carried out at more than one location, occasionally in more than one segment or even in more than one watershed. The ore production listed in Table 2.1-2 is the total production for all mining operations. Section 2.1.7 summarizes the number of mine features from BLM mapping of the watershed.

2.1.6.2 Mills

Table 2.1-2 lists the mills with operations in the Canyon Creek Watershed for which there are records. This table includes the operating years of the mill and a summary of ownership, and the segment in which the mill is located. Not all mills are listed because records were not available for all mills.

2.1.7 Mine Workings

Underground workings in many mines are very extensive and act as collection and distribution systems for groundwater. Many adits and tunnels in the watershed act as discharge points for groundwater. The adit drainage discharges directly to surface water or infiltrates waste rock piles before discharging to surface water from seeps (SAIC 1993c). The mine workings in each segment of the Canyon Creek Watershed are described in the following subsections.

2.1.7.1 Segment CCSeg01

There are 11 mines and 7 unnamed adits within segment CCSeg01.

2.1.7.2 Segment CCSeg02

There are eight mines and one adit within the CCSeg02 area.

2.1.7.3 Segment CCSeg03

There are 12 mines and 1 unnamed adit in segment CCSeg03.

2.1.7.4 Segment CCSeg04

Segment CCSeg04 along Canyon Creek starts at the Hidden Treasure Mine and ends downstream at the West Bell Mine. There are at least 38 mines, 4 mills, and 3 unnamed adits in segment CCSeg04.

The Tiger-Poorman Mine is located along the north side of Canyon Creek. The mine was allowed to flood in 1908 after deeper workings proved disappointing. Drainage from the Tiger-Poorman Mine flows into Canyon Creek. The area has been reworked and the actual locations of adits are unknown.

The Hercules Mine, which operated from 1905 to 1959, is located along the north side of Canyon Creek. Hercules No. 5 is the lowest adit of the Hercules Mine. Hercules No. 5 flows year-round and drains into nearby Gorge Gulch, which flows into Canyon Creek.

The Hidden Treasure Mine is located on the northwest side of Canyon Creek. Originally the mine was an adit associated with the Tiger-Poorman Mine. It was used to access a number of other mines and, therefore, may drain substantial mine workings.

The Hecla-Star Mine and Millsite Complex is located on the east side of Canyon Creek at Burke, Idaho. Discharge from the Star main adit is collected and piped to the Hecla-Star Tailings Ponds. Canyon Creek has been channelized under most of the Hecla-Star Mill buildings.

The Tamarack mine complex is located on Ninemile Creek but the Tamarack No. 7 adit is located on Canyon Creek and drains into Canyon Creek. The adit was originally the No. 6 level of the Standard-Mammoth Mine; however, in 1922 it was changed to the No. 7 level of the Tamarack and Custer, and the adit was extended to the Tamarack vein. The adit may drain substantial mine workings, including Tamarack-Weta and Standard-Mammoth Mine.

The Frisco Mine includes three adits, a millsite, and a tailings pile. The Black Bear Mine is located upstream of the Frisco millsite and consists of several adits located up the hillside from Canyon Creek, and a millsite.

The Gem Mine, millsite, and associated adits are located on the east side of Canyon Creek, downstream from the Frisco millsite. The portal to the mine is plugged with concrete to collect the drainage, which is discharged through a 12-inch-diameter pipe. The buried pipe extends 200 feet from the closed portal to Canyon Creek (MFG 1997).

2.1.7.5 Segment CCSeg05

There are three mines, six tailings ponds, and three mills located in segment CCSeg05.

The tailings ponds for the Hecla-Star Mine are located along the lower reaches of Canyon Creek. The six ponds contain an estimated 3.4 million tons of tailings and occupy approximately

66 acres. The five upper ponds are inactive and have sparse vegetation. Significant erosion can be observed along the side of the ponds. Areas of seepage have been identified and sampled over the past ten years, yielding total lead concentrations in the 1,000 to 2,000 μg/L range, and total zinc concentrations in the 30,000 to 35,000 μg/L range (MFG 1991, Houck and Mink 1994, Liverman 1995, Gearheart, et al. 1999). The lower pond is still active and is used as a settling pond for Star Mine drainage (Box 1999). Measured flow from the lower tailings pond in 1991 was approximately 1 cubic foot per second (cfs) (SAIC 1993c). Measured flow from the outfall pipe (CC811) ranged from approximately 1 to 3 cfs from 1994 to 1998 (see Attachment 2). The tailings ponds were built on the floodplain and it is highly probable that they cover deposits of historic jig tailings.

Canyon Creek flows into the South Fork near the town of Wallace, Idaho. Information indicates that there was an impoundment downstream of Woodland Park where tailings and waste materials accumulated behind a wooden plank dam, resulting in tailings deposits upstream from the impoundment (Houck and Mink 1994). The dam was flooded and destroyed in 1917.

2.2 HYDROGEOLOGY

The Canyon Creek Watershed occupies approximately 22 square miles of land surface. Canyon Creek flows approximately 12 miles from its headwaters in the Bitterroot Mountains to its confluence with the South Fork (MFG 1995). The elevation change in the watershed is approximately 4,000 feet, ranging from 6,700 feet above mean sea level (msl) in the Bitterroots to 2,750 feet above msl at the confluence with the South Fork.

The hydrogeology of the Canyon Creek Watershed can be divided into two main aquifer systems: the bedrock aquifer and the shallow alluvial aquifer. The bedrock aquifer within the Canyon Creek Watershed consists primarily of the Precambrian formations of the Belt Supergroup, including the Wallace and Prichard Formations. The rocks are predominantly quartzites, dolomites, and argillites (Hobbs et al. 1965). In general, the bedrock has very low permeability (open areas in which water can flow). Secondary features such as fractures, faults, or mine workings may increase the permeability substantially. Section 2.1.6 describes the mine workings that may have some influence on groundwater.

The shallow alluvial aquifer consists of unconsolidated alluvium, including natural materials as well as mine tailings and waste rock. In general, the alluvium increases in thickness from the headwaters of Canyon Creek toward its confluence with the South Fork (Ridolfi 1998). Near the mouth of Canyon Creek, the alluvium both narrows and thins. Bedrock is close to the surface and the alluvial channel is limited to about 15 feet in thickness.

In segments CCSeg01, CCSeg02, and CCSeg03, Canyon Creek occupies a narrow valley consisting primarily of exposed bedrock with no substantial alluvial deposits along its banks (Box, Bookstrom, and Kelley 1999). Segment CCSeg04 contains discontinuous areas of alluvium deposits that serve as shallow unconfined aquifers; however, there are no major alluvial deposits until segment CCSeg05.

The hydrogeologic conceptual model for lower Canyon Creek (segment CCSeg05) is an alluvial valley with alluvial aquifers underlain by nearly impermeable bedrock. Data suggest that at least two aquifers exist within the alluvial material, including a shallow unconfined aquifer (average depth 3 to 10 feet below ground surface [bgs]) and a lower semi-confined aquifer (approximately 20 to 27 feet bgs at the location of well WP-3 [Figure 2.2-1]). These two aquifers are separated by a sandy silt to silty sand layer, which has been theorized to form a leaky aquitard (Houck and Mink 1994).

Groundwater elevation in the alluvial aquifer fluctuates seasonally; groundwater is recharged by precipitation, snowmelt, adit drainage, and from losing reaches of Canyon Creek, such as the one at Woodland Park. (A losing reach is a portion of the creek that loses water to the aquifer; a gaining reach is one that gains water from the aquifer.) Groundwater elevations are generally highest in the spring during periods of increased snowmelt and precipitation, and lowest during winter and early spring when precipitation rates are lowest and snowmelt is not occurring (Dames & Moore 1991).

2.2.1 Aquifer Parameters

Aquifer parameters such as hydraulic conductivity and transmissivity are commonly obtained by performing multi-well pumping tests or single-well slug tests. Aquifer test data were not available in any of the references reviewed for this investigation. The only aquifer parameters noted in any of the documents were specific capacities based on data obtained during well development. Monitoring wells installed in 1993 in the Woodland Park area along Canyon Creek were pumped for well development purposes. Specific capacities ranging from 1.3 to 8.9 gallons per minute per foot (gpm/foot) of drawdown were calculated at discharge rates ranging from 2 to 10 gpm during development (Houck and Mink 1994).

The transmissivity of wells where the specific capacity is known can be estimated (Driscoll 1986). The transmissivity for an unconfined aquifer is calculated as follows:

$$T = (Q/s) \times 1{,}500$$

where

T = transmissivity in gallons per day per foot (gpd/foot)
Q = yield of well in gpm
s = drawdown in the well in feet
1,500 = empirical value

Substituting the range of specific capacities for the Q/s term yields transmissivity values ranging from 1.9×10^3 to 1.3×10^4 gpd/foot.

In December 1999, as part of the RI, slug tests were performed in 14 monitoring wells to estimate aquifer characteristics of the shallow alluvial aquifer(s). Although slug tests are a valuable tool for estimating aquifer parameters, it is important to note that they provide estimates for only a small volume of aquifer material around the well. In addition, because the monitoring wells were screened over their entire length, the estimated hydraulic conductivities should be considered as apparent values representative of all the materials encountered.

The hydraulic conductivity values were derived using the solution developed by Bouwer and Rice (1976). The estimated hydraulic conductivities ranged from 20 to greater than 200 feet/day (Table 2.2-1) and are typical of silty sand and sand materials (Freeze and Cherry 1979). The locations of the monitoring wells are shown in Figure 2.2-1.

2.2.2 Water Table Gradients

Based on similar watersheds, it can be assumed that throughout the drainage, the general groundwater flow direction in the Canyon Creek Watershed parallels the flow of Canyon Creek surface water. Out from the creek axis, it is expected that a portion of the flow will be toward the creek. According to water levels in wells installed before 1998, there are localized areas in segment CCSeg05 where the flow direction is downstream and toward the creek and some areas where the flow direction is downstream and away from the creek. This groundwater/surface water interaction is discussed in more detail in the following subsection. A total of 73 wells have been installed in the Canyon Creek Watershed. Through 1993, 38 wells and piezometers were installed in the Woodland Park area; in 1998, 35 additional wells and piezometers were installed (Figure 2.2-1).

2.2.2.1 Pre-1998 Wells

Nineteen monitoring wells and domestic (drinking water) wells were installed in the Woodland Park area before 1993. These wells are constructed with steel casing or are dug wells with large diameters and are not ideal sampling points. In March 1993, five 2-inch-diameter polyvinyl chloride (PVC) monitoring wells were installed. In early July 1993, nine small-diameter (0.75-inch) PVC piezometers and seven shallow 2-inch-diameter monitoring wells were installed. All nine piezometers were installed near Canyon Creek in areas where the depth to groundwater was generally less than 2 feet (Houck and Mink 1994). The piezometers were installed to an average depth of approximately 4 feet bgs. The monitoring wells were installed to an average depth of approximately 7 feet bgs and located to obtain a distribution of sampling points throughout the west side of the Canyon Creek floodplain. Well logs for the monitoring wells indicate a sequence of 2 to 4 feet of jig tailings overlying cobbles and boulders with finer-grained sediments including sand, silt, and mine tailings. A maximum thickness of 8 feet of tailings was observed at one cut bank of Canyon Creek. The water table was from 1 to 8 feet bgs with an average depth of 3 feet bgs (Houck and Mink 1994).

Water level measurements were made in late August and early November 1993 and in early January 1994 on the 21 wells installed in 1993 and most of the 19 pre-1993 wells. Analysis of the water level elevations indicates that the water table aquifer in the Woodland Park area has a fairly steep gradient generally following the ground surface topography. The average gradient is 0.035 and the flow direction is to the southwest (Houck and Mink 1994). The groundwater contour map shown in Figure 2.2-2 confirms this gradient and southwesterly flow direction. The deeper, confined aquifer zone appears to have approximately the same groundwater flow direction, although there are fewer measuring locations in the confined zone (Houck and Mink 1994).

2.2.2.2 1998 Wells in Woodland Park Area

A southwesterly flow direction and a fairly steep gradient of 0.025 was estimated by the analysis of water level elevations in 13 wells installed in 1998 in the Woodland Park area, at locations CC452, CC456, CC459, CC460, CC462, CC463, CC464, CC465, CC468, CC469, CC477, CC480, and CC481. These 13 wells were screened in alluvium just above the top of bedrock. The depth to bedrock varies according to the location within or on the periphery of Canyon Creek; however, it is generally between 15 and 45 feet bgs. The depth to groundwater generally ranges from 3 to 8 feet bgs. The unconsolidated material encountered during the drilling of these wells was consistent with the material encountered in the pre-1998 wells.

2.2.2.3 1998 Wells in Gem Area

In segment CCSeg04 (between Gem and Mace), a total of eight wells were installed within or immediately adjacent to Canyon Creek, at locations CC449, CC441, CC440, CC434, CC423, CC433, CC422, and CC419. Like in the Woodland Park area, a southwesterly flow direction and a steep gradient is inferred from an analysis of water level elevations in the eight wells along this reach of the creek. These eight wells were screened in alluvium just above the top of bedrock. The depth to bedrock varies according to the location within or on the periphery of Canyon Creek; however, it is generally between 15 to 35 feet bgs. The depth to groundwater generally ranges from 8 to 10 feet bgs. The unconsolidated material encountered during the drilling of these wells was consistent with the material encountered in the wells in the Woodland Park area.

2.2.2.4 1998 Wells in Mace Area

In segment CCSeg04 (between Mace and Burke), a total of eight wells were installed within or immediately adjacent to the main creek channel, at locations CC401, CC402, CC403, CC409, CC414, CC415, CC417, and CC418. As with the Woodland Park Area, a southwesterly flow direction and a steep gradient is inferred from an analysis of the water level elevations in the eight wells along this reach of the creek. Like the other 1998 wells, these wells were screened in a similar unconfined alluvial aquifer yielding unconfined conditions, and the depth to bedrock is generally between 15 to 25 feet bgs. Depth to water generally ranges from 8 to 10 feet bgs.

2.2.3 Surface Water/Groundwater Interaction

Shallow alluvial deposits along Canyon Creek serve as aquifers, and if they are hydraulically connected, they are capable of taking from or adding to flow in the creek, resulting in losing or gaining reaches. During the spring snowmelt and resulting high creek levels, the gaining reaches of the stream may temporarily experience reversals in the surface water/groundwater hydraulic gradient (i.e., become losing reaches).

2.2.3.1 Segments CCSeg01, CCSeg02, and CCSeg03

In general, the flow in the upper part of Canyon Creek remains fairly constant, neither gaining nor losing, from near the headwaters to the Tamarack Mine portal (near location CC422). In these segments, Canyon Creek is cut into a narrow valley consisting primarily of exposed bedrock, with no significant alluvial deposits along its banks (Box, Bookstrom, and Kelley 1999).

2.2.3.2 Segment CCSeg04

Below the Tamarack Mine portal (from CC422 to CC440) the flow generally increases. However, 1991 flow data indicates an increased flow of approximately 83 to 230 cfs (MFG 1991). It seems unlikely that the increased flow in Canyon Creek could be attributable to the several small surface drainages that enter Canyon Creek in this section of the river.

Possible sources that could account for the anomalous increase in flow along this segment of Canyon Creek include unknown mine portals or tunnels and increased groundwater inflow unrelated to mining activities, possibly along a fault or other secondary permeability features in the bedrock aquifer. The geologic map of the Coeur d'Alene district (Gott and Cathrall 1980) indicates that the Frisco Fault cuts across Canyon Creek between CC422 and CC440, in the same area where increased flow is noted in Canyon Creek (MFG 1991).

2.2.3.3 Segment CCSeg05

The net flow in Canyon Creek generally declines during high-flow conditions from below CC440 to near the mouth of Canyon Creek. Under low-flow conditions (at or near baseflow) there is a slight increase in streamflow. In this segment, the valley widens, the channel gradient decreases, and accumulations of alluvium and alluvium mixed with tailings in Canyon Creek become more prevalent. The accumulated sediments along Canyon Creek create additional groundwater storage capacity. In general, the creek loses water where the volume of valley sediments increase and gains groundwater where the volume of valley sediments decrease. For example, the Formosa reach and Upper Pond reach within segment CCSeg05 are losing water to the unconfined alluvial aquifer (i.e., losing reaches) (MFG 1995). The Woodland Park reach and the lower reach with CCSeg05 are gaining water from the unconfined alluvial aquifer (i.e., gaining reaches) (MFG 1995). The boundary between losing and gaining reaches appears to shift downstream during high flow events (MFG 1995).

The USGS completed a seepage study for a 3.7-mile reach of Canyon Creek extending from near the mouth to near the upstream end of CCSeg05 (Barton 2000). This study examined losing and gaining subreaches within CCSeg05. According to this study, Canyon Creek lost surface water to groundwater from near the upstream boundary of CCSeg05 to CC17. From near CC17 downstream to CC285, the channel gained groundwater. From CC285 downstream to CC286, the channel lost channel flow to groundwater. From CC286 downstream to approximately

CC457, the channel gained flow from groundwater. From CC457 downstream to CC287, the channel lost flow to groundwater. During the October sampling event, the study indicates that the entire study length gained surface water from groundwater except form CC285 to CC286 where the channel lost groundwater. This study indicates that the boundaries of losing and gaining reaches may shift with discharge or other parameters.

The Osburn Fault intersects Canyon Creek just south of the Hecla-Star Tailings Ponds. This geologic feature may affect the permeability of the bedrock and may cause localized discharge to the shallower aquifers. However, little information is available regarding bedrock aquifer conditions.

In 1993, a refractive geophysical investigation within the floodplain area near Woodland Park was conducted in the CCSeg05 area (Houck and Mink 1994). The purpose of the work was to determine depth to bedrock to help characterize the aquifer system in the unconsolidated sediments. The results of this geophysical survey confirm a shallow alluvial groundwater system underlain by bedrock, generally less than 30 to 50 feet bgs in most places. Exposed bedrock is present in the creek bottom in the lower portion of the valley, suggesting that the alluvial groundwater system is thinner in this area. Unless a buried alluvial aquifer of significant permeability exists outside the geophysics study area, most of the groundwater flow in the alluvial aquifer likely discharges into Canyon Creek at its lower end (Houck and Mink 1994).

2.2.4 Groundwater Quality and Chemistry

Water quality parameters (temperature, pH, specific conductance, salinity, turbidity, oxidation-reduction (redox) potential, and dissolved zinc were measured to evaluate changes in water quality in the alluvial aquifer as groundwater moves downgradient through the Canyon Creek Watershed. Water quality data from the 1998 wells in the Gem area and the Mace area are presented in Table 2.2-2. Water chemistry data (chloride, sulfates, and sulfides) from the 1998 wells in the Woodland Park, Gem, and Mace areas are presented in Table 2.2-3. Water quality data from the pre-1998 wells in the Woodland Park area are presented in Table 2.2-4 (MFG 1998).

Unless noted otherwise, the following statements apply to the groundwater conditions throughout Canyon Creek, based on groundwater sampling at widely spaced locations:

- Salinity values are typical of freshwater conditions (Table 2.2-2).
- The pH in Canyon Creek above Woodland Park are commonly between 6.25 and

7.25, or slightly acidic (Table 2.2-2). The pH in the Woodland Park area is more strongly acidic, generally ranging from 4.5 to 6.5 (Table 2.2-4).

- The redox potential, the ability of a specific groundwater environment to bring about any oxidation or reduction process, is oxidizing at most sampling locations, although reducing tendencies are locally observed in discrete locations throughout Canyon Creek (Table 2.2-2).

- Specific conductance is the ability of groundwater (in this case) to conduct an electrical current and is also a measure of the amount of dissolved minerals in solution. There is a positive correlation between elevated specific conductance, chloride content, and sulfate content (e.g., see locations CC402, CC415, CC422, and CC452 in the Mace and Gem areas [Tables 2.2-2 and 2.2-3]).

- Sulfides are not present at detectable concentrations (Table 2.2-3).

- Dissolved zinc concentrations were not correlated with any of the other water quality parameters reported (Table 2.2-2).

2.2.5 Groundwater Use

Surface water in creeks and groundwater in shallow unconfined alluvial aquifers are potential domestic water sources in the watershed. Water-rights records indicate that one groundwater source in the Gem area is used for domestic purposes only. The records also indicate that 10 surface water sources and five groundwater sources/springs in the watershed are used for domestic purposes or irrigation (Ridolfi 1998).

Although the shallow aquifer in Canyon Creek produces an adequate supply of groundwater for domestic use and there are still water rights on record, private wells are no longer used for domestic water supply because of poor groundwater quality (Mink, Williams, and Wallace 1972). Groundwater samples indicate that groundwater quality in the lower Canyon Creek has been degraded by the release of heavy metals (Houck and Mink 1994). In 1970, the Woodland Park Water Association was formed. The East Shoshone County Water District extends up Canyon Creek to the Woodland Park area.

2.3 SURFACE WATER HYDROLOGY

Surface water hydrology of Canyon Creek, a tributary to the South Fork Coeur d'Alene River, is described in this section. The Canyon Creek Watershed has a drainage area of approximately 21.9 square miles with approximately 11.7 miles of mapped channel length, and a drainage density of 0.5 miles per square mile.

2.3.1 Available Information

The available hydrologic information for Canyon Creek includes United State Geological Survey (USGS) stream flow data for Canyon Creek for water year 1999, climatological data for Wallace, Idaho, and instantaneous discharge data from a variety of consultants from 1991 to 1999. In addition, historical USGS discharge data is available for Placer Creek, of similar size and near Canyon Creek.

USGS began reporting stream flow discharge data from Station 12413125, Canyon Creek, above the mouth at Wallace, Idaho, on October 1, 1998 (USGS 2000a). This station is located at the downstream end of CCSeg005. This station records water stage (elevation of the water surface) at 15-minute intervals. Discharge is calculated from the stage data based on a rating curve developed for the specific gage. The rating curve is developed through time by measuring discharge at known stages to relate stage to discharge. Once a rating curve is developed, a discharge can be calculated by comparing a known stage to the rating curve. One complete year of discharge data, water year 1999, is available for Canyon Creek at Wallace at this time. Water year 1999 ran from October 1, 1998 to September 30, 1999. Precipitation data from the Western Regional Climate Center (WRCC) station at Wallace were collected for the same period (WRCC 2000). This precipitation gage is the nearest gage to Canyon Creek. The mean daily discharge hydrograph and precipitation data are presented in Figure 2.3-1. The maximum discharge recorded during water year 1999 was 440 cfs, on May 25, 1999. The minimum recorded discharge for this period of record was 9 cfs on both December 20 and 21, 1998.

The USGS also has developed synthetic hydrographs for two additional stations on Canyon Creek: Canyon Creek at Woodland Park, Idaho, Station 124131237, and Canyon Creek, near Burke, Idaho, Station 12413118 (USGS 2000b). The synthetic hydrographs were developed for water year 1999. The Woodland Park Station is located in CCSeg05 and the station near Burke is located in CCSeg04. These hydrographs are presented in Figures 2.3-2 and 2.3-3. To develop these hydrographs, the USGS measured stream flow at the flow gaging locations over a range of water stages, twelve total measurements, during water year 1999. These measurements were correlated to mean daily flow at Station 12413125, Canyon Creek at Wallace. This correlation provided a relationship between discharge at Canyon Creek at Wallace with Canyon Creek at Woodland Park, and near Burke. The relationship was used with the continuous stream flow data from the gage at Canyon Creek at Wallace to develop the synthetic hydrographs presented in Figures 2.3-2 and 2.3-3 for water year 1999. This method appears to give good results, as indicated by reported r^2 values of 0.99 and 0.95 for the correlation analyses for the data from stations at Woodland Park and Burke, respectively. The residuals of the correlation analysis are greatest for large discharges, indicating there may be greater uncertainty in the predicted discharge for higher flows. The discharge values from this synthetic hydrograph are used in mass loading calculations in Section 5 of this report.

In addition to the USGS gage on Canyon Creek, the USGS has several gages in the area with historical stream flow data, most notably USGS station number 12413140, Placer Creek at Wallace, Idaho. The Placer Creek gage has a drainage area of 14.9 square miles and a period of record from November 1967 to September 1995, October 1996 to September 1997, and water year 1999 (USGS 2000c). These data can also be used to derive synthetic hydrographs and discharges for floods of specific recurrence intervals within Canyon Creek.

Stream discharge measurements were taken in association with water quality sampling events completed by McCulley, Frick & Gilman, Inc. (MFG), URS, Idaho Department of Environmental Quality (IDEQ), and USGS. These measurements have occurred since 1991. These data can be used to evaluate the adequacy of the synthetic hydrographs developed from the Placer Creek data. These data are summarized in Table 2.3-1.

In addition to the USGS hydrologic information, the U.S. Department of Housing and Urban Development, Federal Insurance Administration completed a Flood Insurance Study (FIS) for the City of Wallace, Idaho, in 1979 (FIA 1979). Computed peak discharges for 10-year (1,100 cfs), 50-year (2,400 cfs), 100-year (3,250 cfs) and 500-year (5,870 cfs) events at the mouth of Canyon Creek were reported. Although these values might be dated, and coefficients used to calculate these discharges may contain some error, they do provide a comparison with the flows in recurrence intervals calculated using the Placer Creek data.

2.3.2 Hydrologic Description

The hydrology of Canyon Creek based on water year 1999 stream discharge, precipitation data, and estimates of historical USGS discharge data from Placer Creek are presented in this section. Base flow discharge is estimated at 10 to 15 cfs, maximum discharge is estimated at 3,230 cfs, and the minimum discharge is estimated at less than 0.5 cfs. These estimates are based on discharge data from water year 1999 for Canyon Creek and historical data from Placer Creek dating from 1967.

2.3.2.1 Historical Description

Continuous data prior to 1999 is not available for Canyon Creek; therefore, an estimate of mean daily discharge at the mouth of Canyon Creek was developed from historical data from Placer Creek. Mean daily discharge for Placer Creek, water year 1999, was scaled by the ratio of the drainage area of Canyon Creek to Placer Creek to produce an estimate of mean daily discharge for Canyon Creek. The difference between the estimated discharge and measured discharge was calculated. The hydrographs and difference are shown in Figure 2.3-4. The relationships developed correlates well with base flow and timing of high flow events, and overestimates the peak daily mean discharge by about 20 percent. Seasonal differences are evident in the estimates from this method with the estimated discharge overestimating flows during the fall, winter and spring, while underestimating flows in the summer. This relationship may be shown as:

$$Q_{canyon}=(Q_{placer}*DA_{canyon}/DA_{placer})$$

or

$$Q_{canyon}=1.47Q_{placer}$$

This relationship was applied to the entire historical data set from Placer Creek to estimate historical discharge in Canyon Creek, Figure 2.3-5. The maximum discharge recorded at the Placer Creek gage is outside the period of record; however, the USGS has estimated this discharge at 2,200 cfs on February 9, 1996. Applying the above relationship results in an estimate of maximum discharge for Canyon Creek of 3,230 cfs. Maximum mean daily discharge based on this analysis is approximately 1,320 cfs and summer base flow is 3 to 5 cfs. Minimum discharge for the period of record is about 0.4 cfs.

2.3.2.2 Flood Frequency

Because historical discharge data are not available for Canyon Creek prior to 1999, Placer Creek historical data were used to estimate flood frequency for Canyon Creek. A flood frequency analysis was completed for Placer Creek and the relationship developed to estimate mean daily discharge from Placer Creek discharge was applied to estimate discharges with specific recurrence intervals.

Peak annual discharge for Placer Creek for the period of record were used with the USGS computer program PEAKFQ2.4 (USGS 1998) to calculate the discharge and 95 percent confidence intervals at various recurrence intervals. PEAKFQ2.4 performs the flood frequency calculations based on Bulletin 17B, from the Interagency Advisory Committee on Water Data (USGS 1982). These values were scaled with the relationship developed for mean daily discharge to obtain an estimate of discharges of specific recurrence intervals for Canyon Creek, Table 2.3-2. Values corresponded well with discharges for the 10-, 50-, and 100-year peak discharges flood events reported by the FIA in 1979.

The bankful discharge, the approximately 1.5 year event, is estimated to be approximately 400 cfs.

2.3.2.3 Water Year 1999

Total annual average precipitation at the WRCC Wallace at Woodland Park Station for the 51-year period of record is 37.7 inches while for water year 1999 the total precipitation was 39.8 inches (WRCC 2000). Total annual average snowfall for the WRCC station is 85.1 inches while for water year 1999 the total snowfall was 82.2. While these comparisons do not address monthly variations in precipitation, they do indicate that the water budget for water year 1999 was typical.

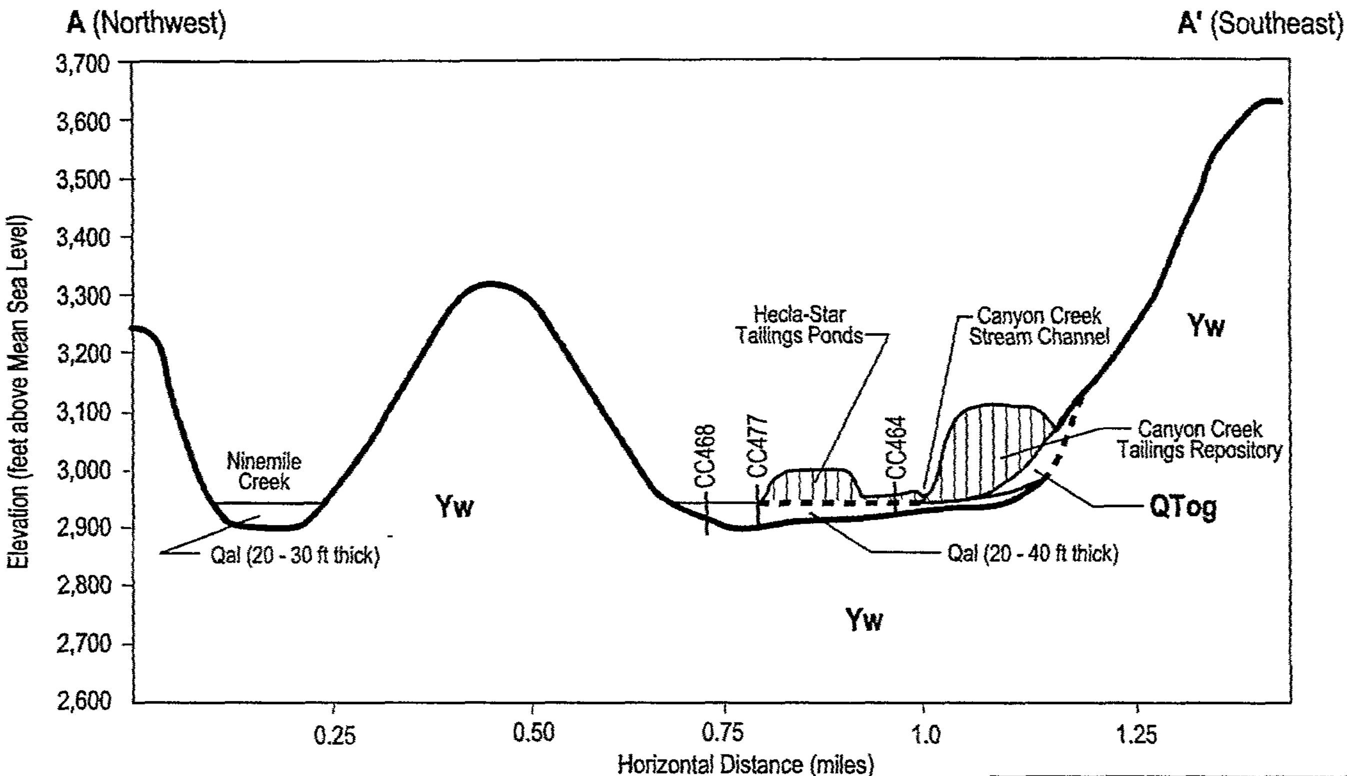
The mean monthly flows for Canyon Creek at Wallace, mean monthly precipitation (rain and snow water content), and total snowfall at the WRCC station at Wallace, Woodland Park are summarized in Table 2.3-3. Table 2.3-3 and Figure 2.3-1 indicate the majority of precipitation, 83 percent, occurred from October to March. Much of this precipitation was in the form of snow that did not run off into the channel immediately.

As indicated in Table 2.3-3, stream discharges remained relatively low through February 1999. Small increases in discharge are noticeable in response to precipitation events in Figure 2.3-1 through the end of March 1999.

The majority of discharge in Canyon Creek during water year 1999 was produced during spring and summer. The increase in discharge during the spring and summer is attributed to increased runoff caused by snowmelt. Increased discharges began in late March and continued through July 1999. Maximum daily temperature and mean daily discharge for water year 1999 are presented in Figure 2.3-6. Two periods of increased maximum temperature correspond very well with the peak discharge events for water year 1999: May 23 to June 6 and June 11 to July 3.

Increased temperatures over these periods melted much of the snow in the upper watershed. Rain on snow also contributed to these increased discharges as indicated in Figure 2.3.2-3.

In summary, water year 1999 was typical from a total snowfall and total water budget perspective in the Canyon Creek Watershed. Runoff from spring snowmelt dominates the surface water hydrology. Variations in snowfall, temperature, and rainfall from year to year will influence the peak discharges.



Legend

Qal - Alluvium and Tailings

QTog - Channel and Terrace Gravels

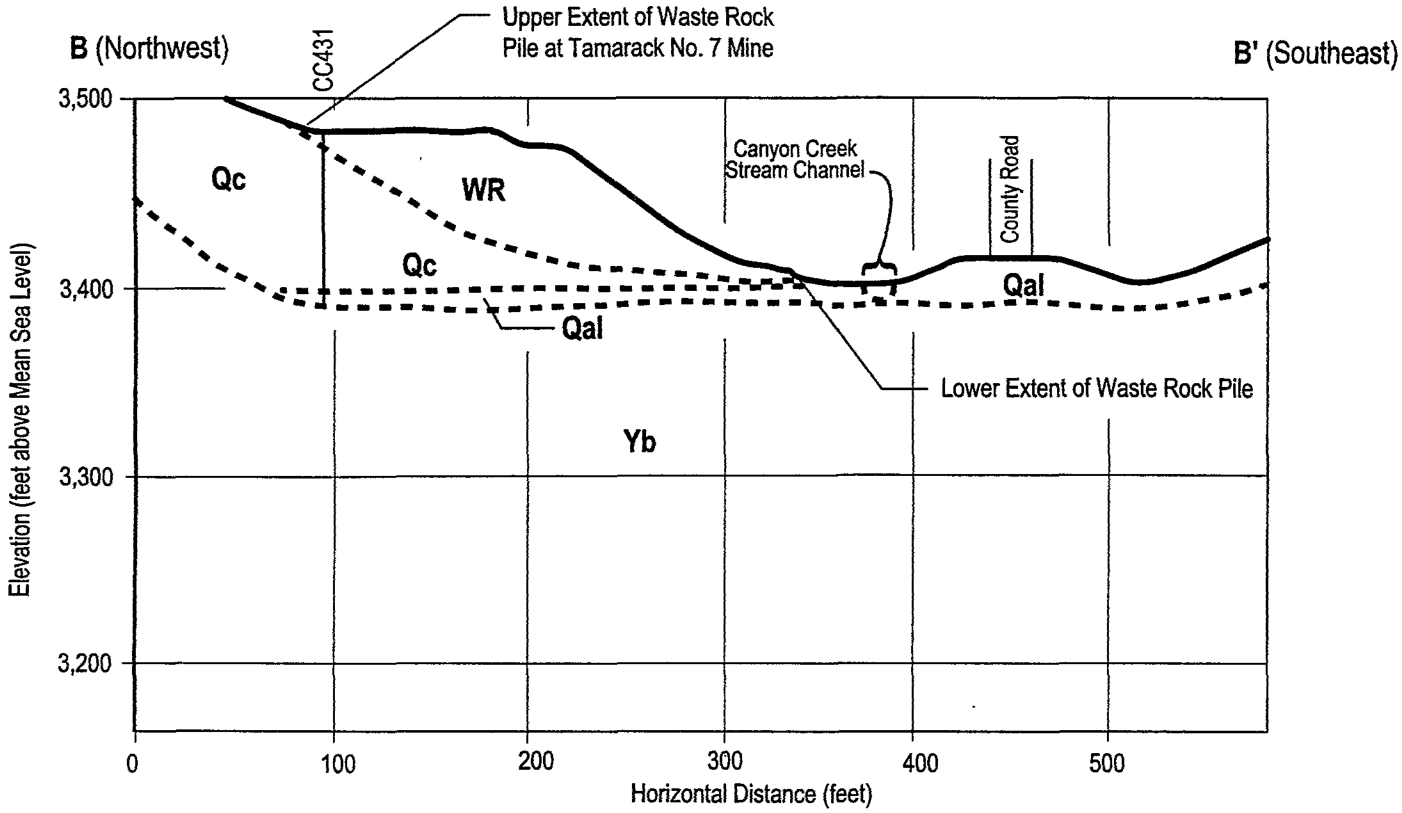
Yw - *Wallace Formation*, Belt Supergroup

- Geologic Contact, Dashed Where Approximated

CC477 - Groundwater Monitoring Well

Vertical Exaggeration = 4x

Figure 2.1-1
Geologic Cross Section A-A'



Legend

WR - Waste Rock Pile

Qc - Quaternary Colluvium (Unconsolidated Soil Transported by Gravity)

Qal - Quaternary Alluvium

Yb - Burke Formation, Precambrian Belt Supergroup

- Geologic Contact, Dashed Where Approximated

CC431 - Groundwater Monitoring Well

EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc. Control: 4162500.6615.05.a Generation: 1 CC-023 071901	**Figure 2.1-2** **Geologic Cross Section B-B'**

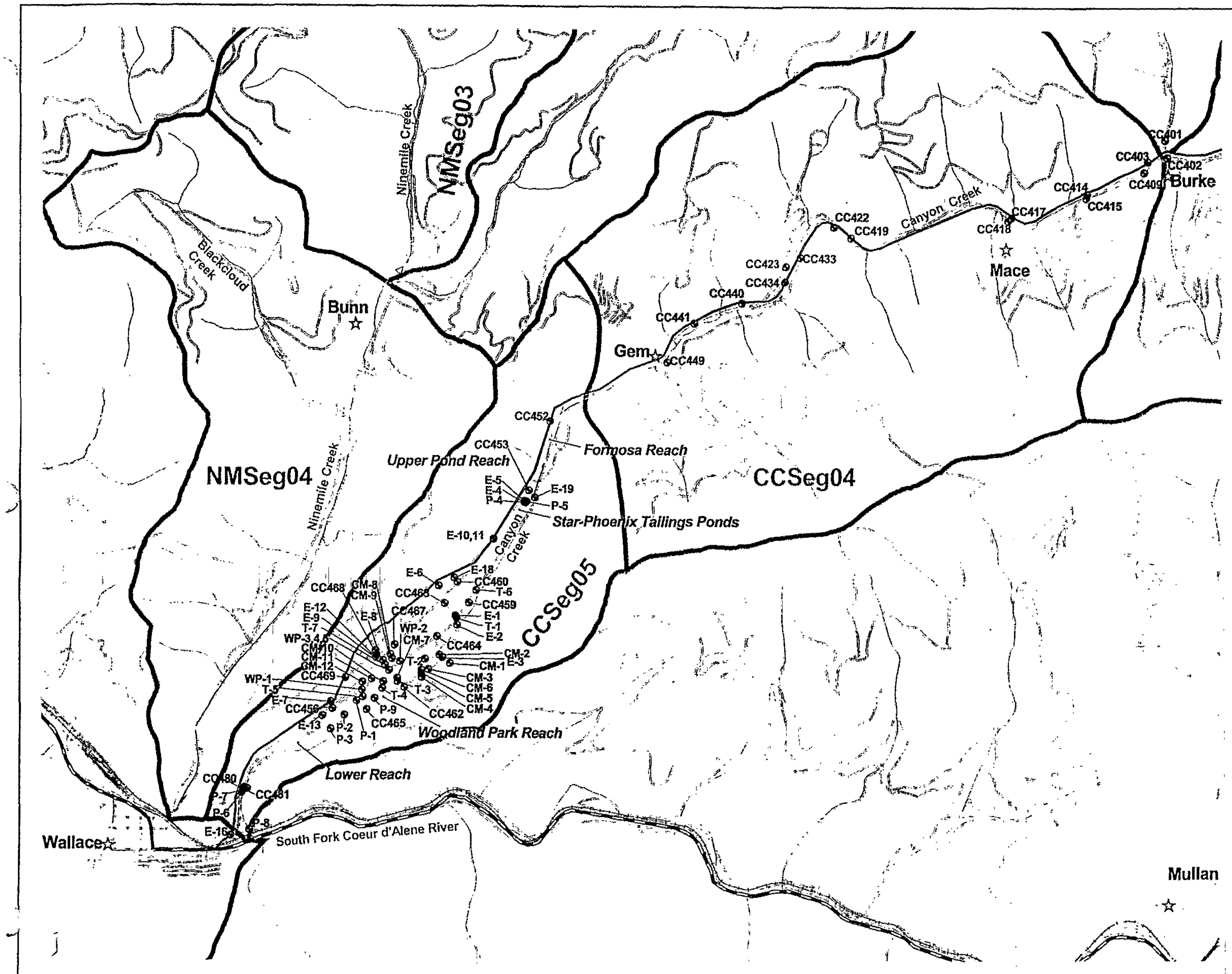


Figure 2.2-1
Locations of Wells in Canyon Creek Watershed

LEGEND

- CC469 — Monitoring Well Installed by URS Greiner, Inc. (2-inch)
- CM-10 — Monitoring Well Installed by McCulley, Frick & Gilman, Inc. (2-inch)
- WP-5 — Monitoring Well Installed by McCulley, Frick & Gilman, Inc. (2-inch)
- T-4 — Monitoring Well Installed by Univ. of Idaho 2-inch)
- P-8 — Piezometer Installed by Univ. of Idaho (3/4-inch)
- E-4 — Well Existing Prior to 1993
- Stream
- I-90
- Road
- Railroad
- City
- Segment Boundary

LOCATION MAP

NOTES

1) Map data were obtained fom the Bureau of Land Management, CH2M HILL, and URS Greiner, Inc.

2) Map includes well locations provided in Houck and Mink 1994 and MFG 1998.

1000 0 1000 2000 Feet

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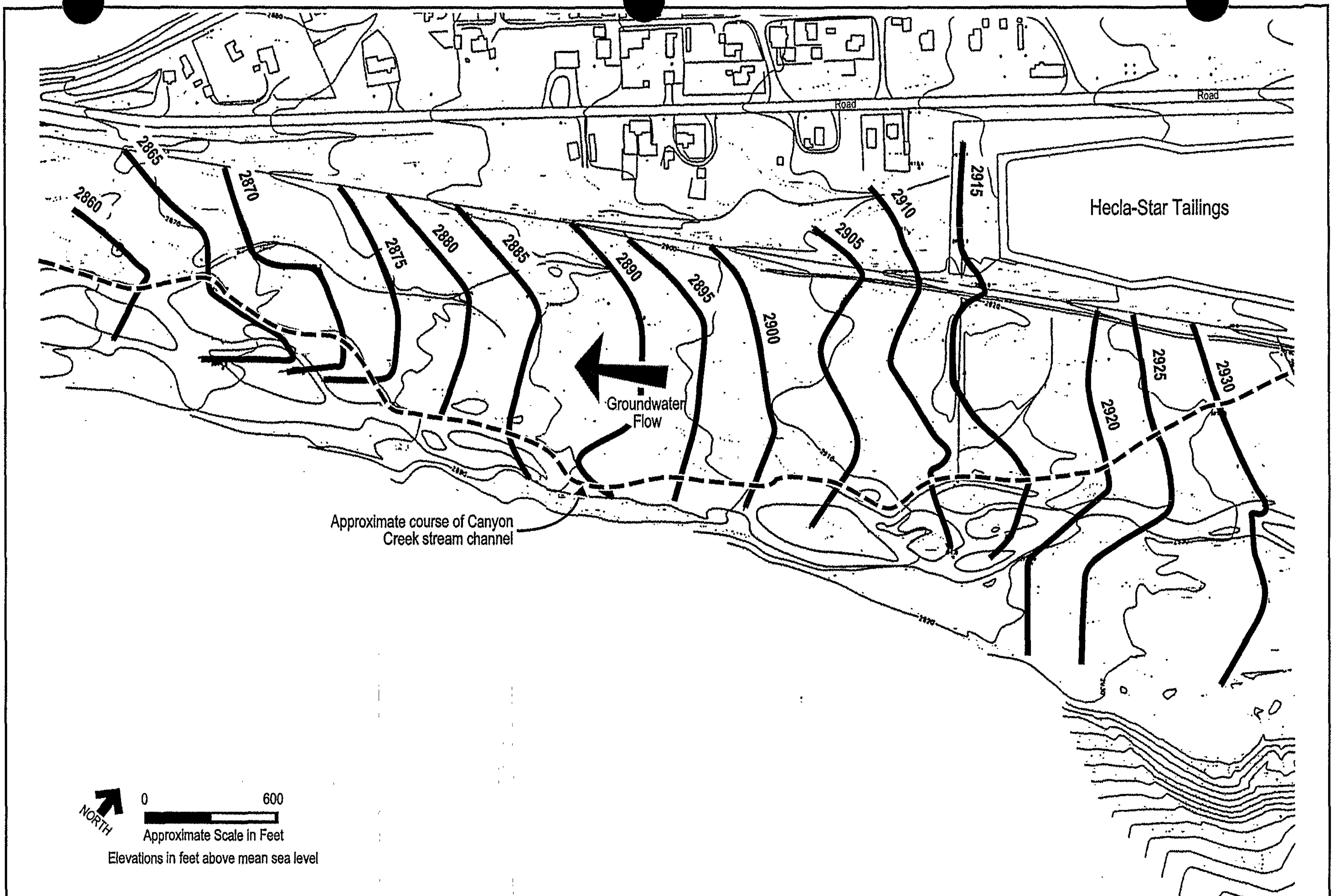
n:\Projects\RI_Fs\Canyon Creek\CC-1.apr
VIEW: fsp08-1
EXTENT:CCSeg04
LAYOUT: Final RI cc-1 Layout
7/19/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 19, 2001



Source: McCulley, Frick & Gilman 1995, Appendix B.

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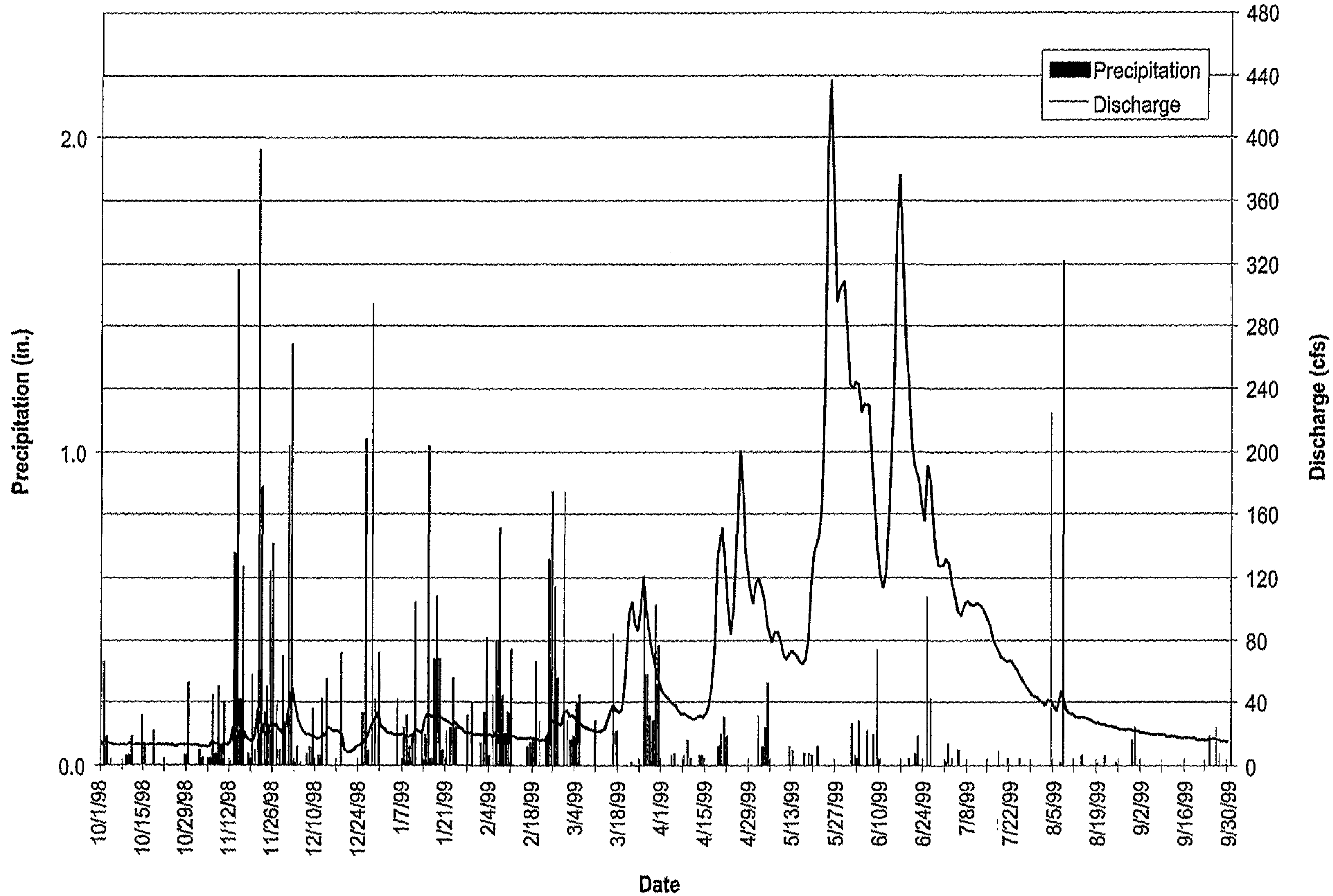
CC-07
071100

Figure 2.2-2
Groundwater Contour Map of Woodland Park Area



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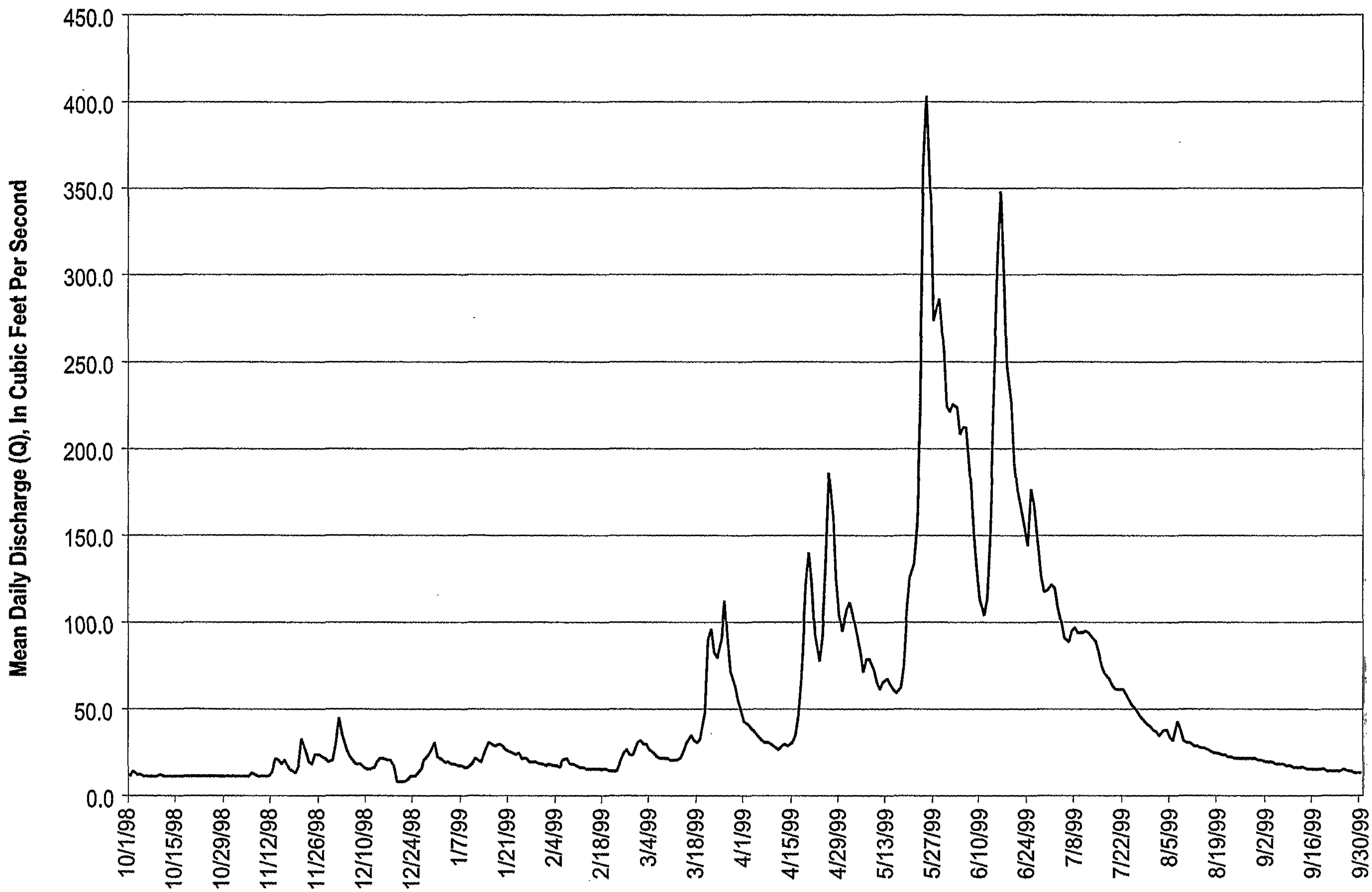
011700

Figure 2.3-1
Daily Total Precipitation and Daily Average Discharge for Canyon Creek Near Wallace
USGS Station 12413125 Water Year 1999



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011700

Figure 2.3-2
USGS Synthetic Hydrograph, Canyon Creek at Woodland Park
Station 12413123, Water Year 1999

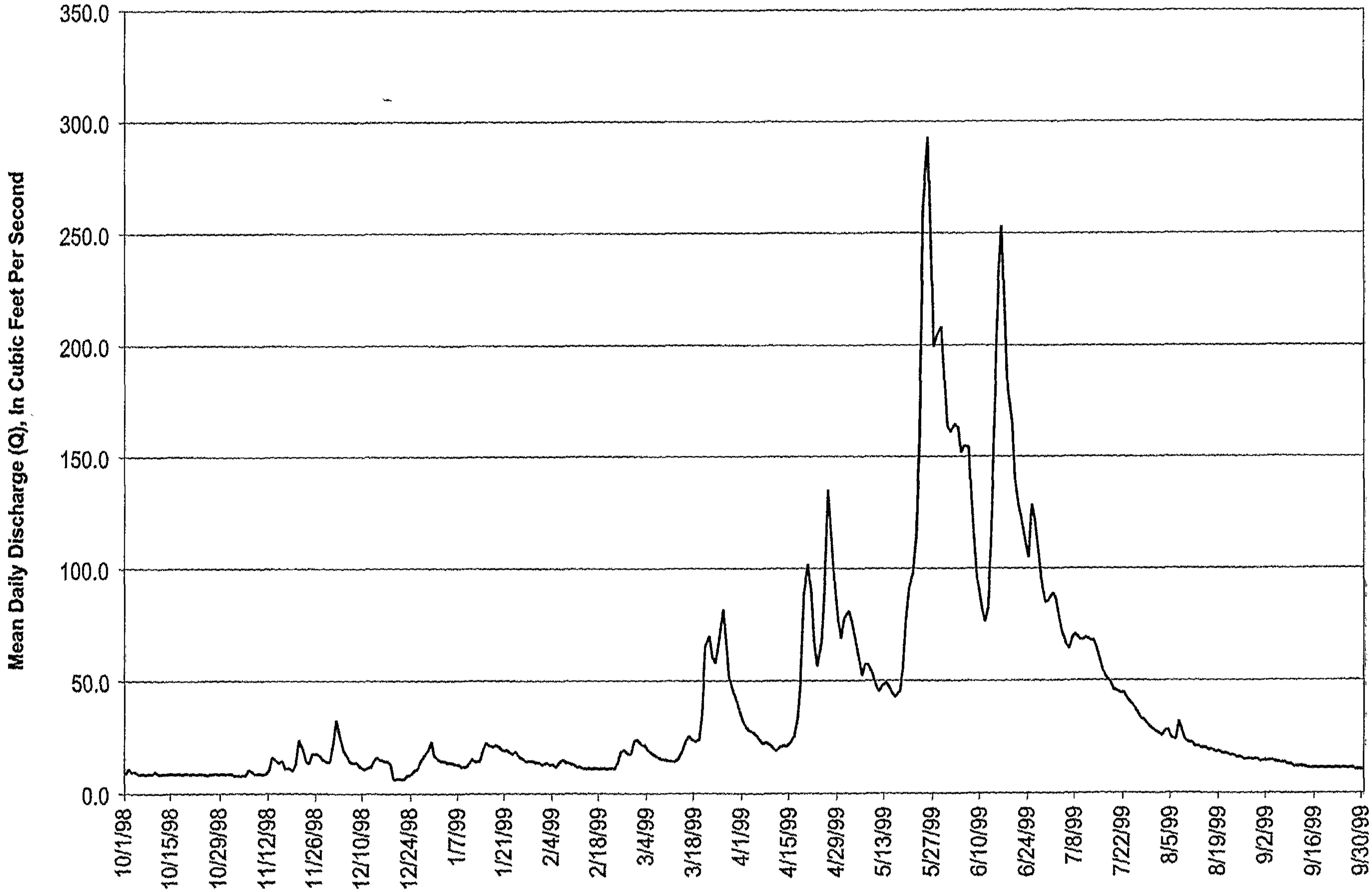

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Figure 2.3-3
USGS Synthetic Hydrograph, Canyon Creek near Burke
Station 1243118, Water Year 1999

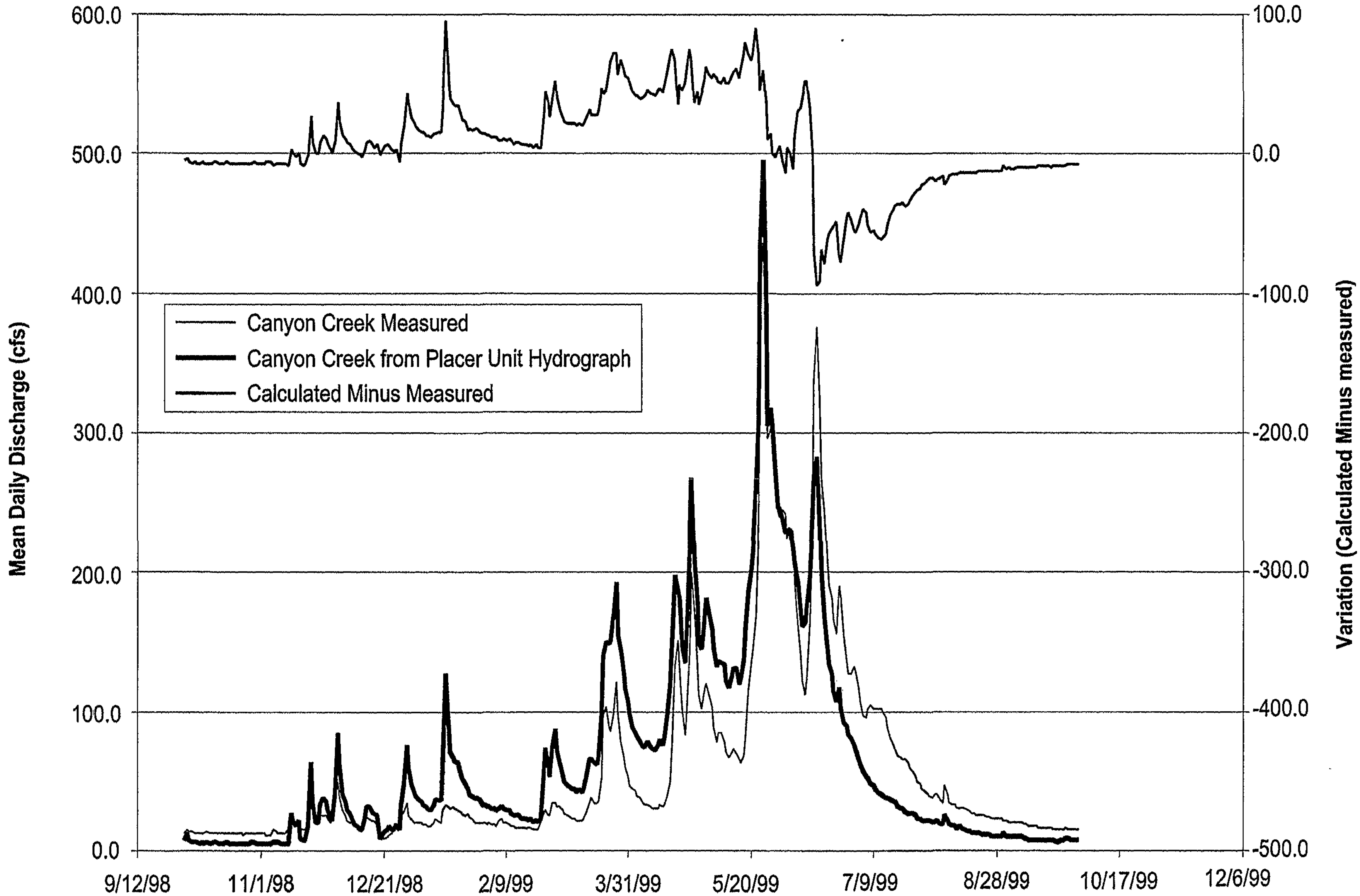

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Figure 2.3-4
Canyon Creek Measured Discharge and Calculated Discharge From Placer Creek Unit Hydrograph

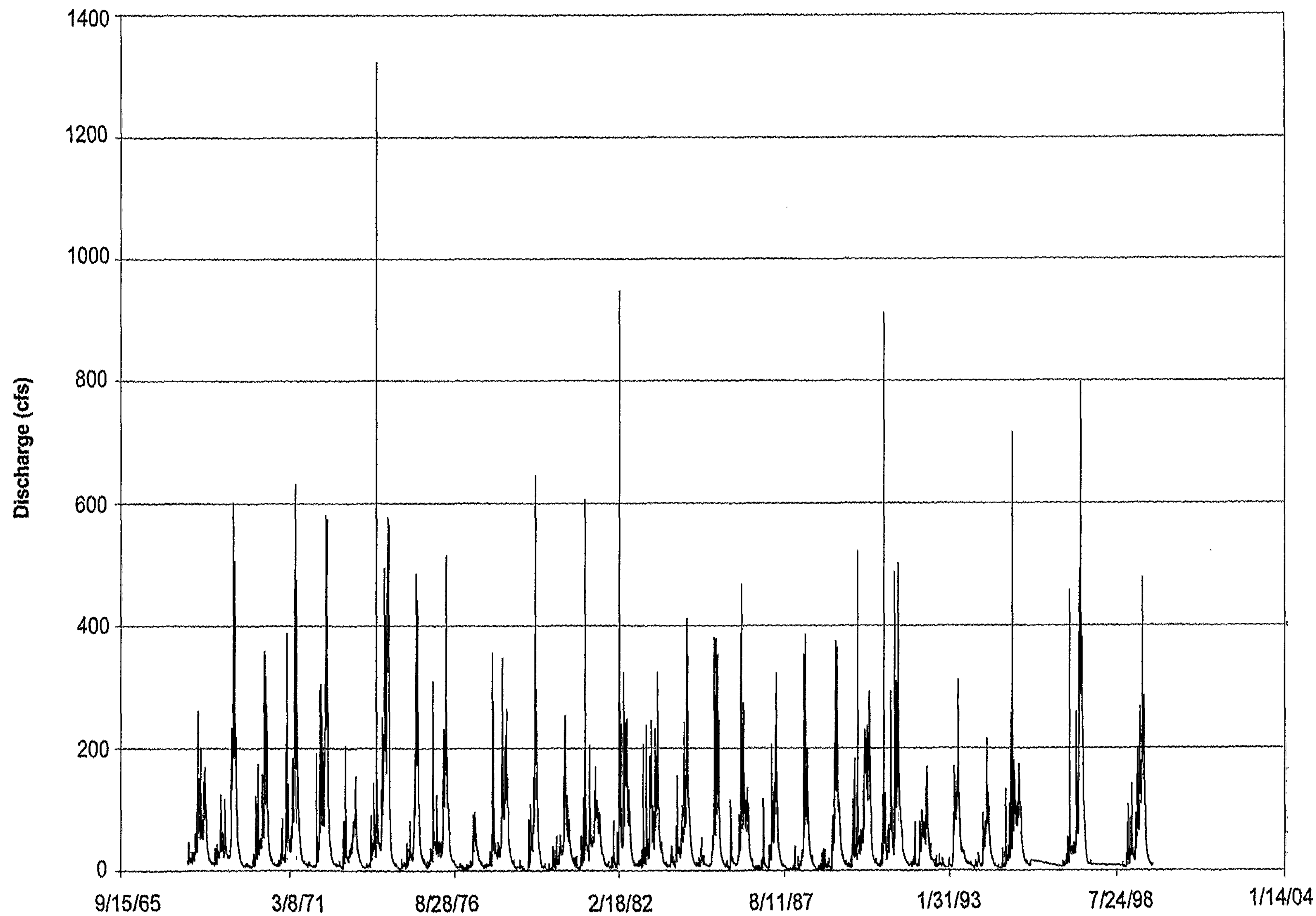

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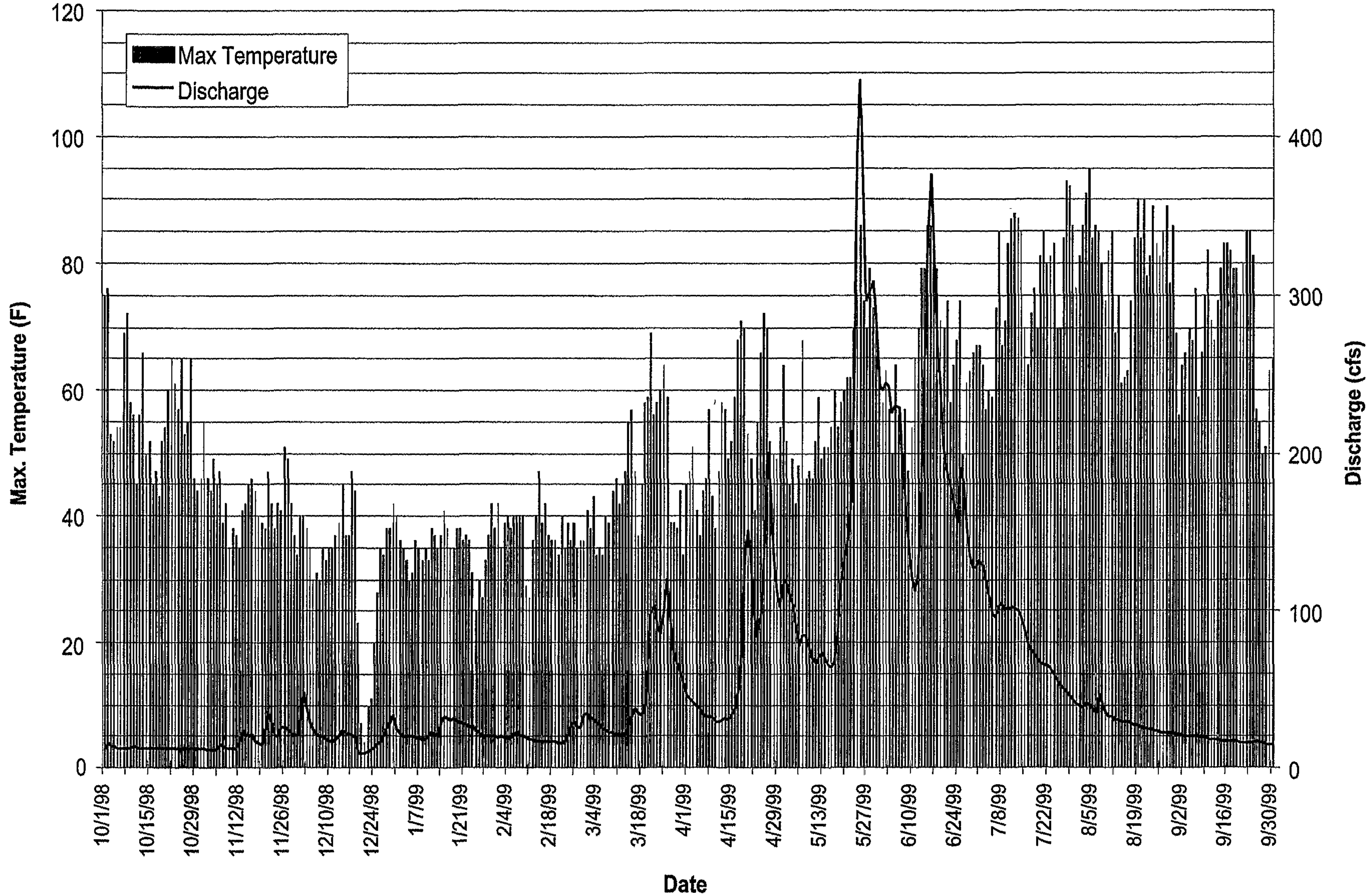
Figure 2.3-5
Canyon Creek Synthetic Hydrograph From Placer Creek Discharge



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc. Control: 4162500.6615.05.a Generation: 1 CC-35 071200	**Figure 2.3-6** **Daily Maximum Temperature and Daily Average Discharge for Canyon Creek Near Wallace** **USGS Station 12413125, Water Year 1999**

Table 2.1-1
Mines in Canyon Creek Watershed With Recorded Production

Mine	Segment	Production Years	Ore (tons)	Mill	Tailings (tons)	Comments
Ajax	CCSeg02 CCSeg03	1922 - 1951	6,235	Bunker Hill Complex	5,020	Small producer
Anchor Group	CCSeg04	1937 - 1951	2,589		2,104	Small producer
Benton	CCSeg03	1955 - 1956	625		517	Small producer
Black Bear Fraction	CCSeg04	1927 - 1973	19,727	Amy-Matchless	17,035	The Black Bear Mine is associated with the Black Bear Fraction Claim, not the Black Bear Claim. Development on the Black Bear Fraction Claim dates from 1906, with initial production in 1927 (Mitchell and Bennett 1983b; SAIC 1993b). The mine operated intermittently during its production history.
Canyon Silver (Formosa)	CCSeg05	1931 - 1938/ 1966 - 1974	24,246	On site	20,250	The earliest recorded production date for the Formosa Mine is 1931 (Mitchell and Bennett 1983b). The property was not operated between 1933 and 1962. No records were found for 1962 through 1966. The mine was reopened in 1966 as the Canyon Silver and it produced ore through 1974 (SAIC 1993b; Mitchell and Bennett 1983b).
Fairview/Wide West	CCSeg03	1945 - 1950	57,186		50,853	Small producer
Greenhill Cleveland	CCSeg04	1902 - 1918	791,447		580,641	Access to the Greenhill Cleveland Mine was through the Standard-Mammoth Mine (Fahey 1978). The productive life of the mine was short, from 1902 to 1918 (Mitchell and Bennett 1983b).

Table 2.1-1 (Continued)
Mines in Canyon Creek Watershed With Recorded Production

Mine	Segment	Production Years[a,b]	Ore[b] (tons)	Mill[a]	Tailings[b] (tons)	Comments
Hecla	CCSeg04	1898 - 1944	7,686,967	Hecla, Gem, Standard, Marsh/ Blackcloud, Union	6,700,193	The Hecla Mine was the second largest producer in Canyon Creek. Ore was first produced from the mine in 1898 via the Hecla No. 3 Tunnel, which later provided access to the Star Mine. Production ceased in 1944 (Ridolfi 1998).
Helena-Frisco (Black Bear, Frisco, Gem)	CCSeg04	1897 - 1967	2,676,379	Helena-Frisco, Black Bear, Frisco, Gem	2,144,173	The Black Bear (Black Bear, Brown Bear, Black Bear Fractional, Surprise, Brown Cub, Black Cub), Badger San Francisco (Frisco), and Gem of the Mountains Claims were located in 1884. Production on the Gem and Frisco Claims dates from 1889 or earlier (Magnuson 1968). Production on the Black Bear Claim dates from 1890 or earlier. The mines were consolidated around 1901 (SAIC 1993b) and became known as the Helena-Frisco Mine. Production is recorded up until 1967 (Mitchell and Bennett 1983b).
Hercules	CCSeg03 CCSeg04	1901 - 1965	3,519,592	Hercules, Hercules (Wallace), Tiger-Poorman, Sherman	2,259,849	The Hercules Mine was the fourth largest producer in Canyon Creek. Ore was first produced on the original Hercules Claim in 1901 (Bennett 1997; Mitchell and Bennett 1983b). After about 1914, all mining operations for the Hercules were conducted out of the Hercules No. 5 Tunnel. By 1925, most of the orebody had been mined and the Hercules Mine was closed. The mine reopened in 1947 and operated intermittently until 1965 (Mitchell and Bennett 1983b).
Honolulu[c]	CCSeg03	1919 - 1934	16,786		14,074	Small producer

Table 2.1-1 (Continued)
Mines in Canyon Creek Watershed With Recorded Production

Mine	Segment	Production Years[a,b]	Ore[b] (tons)	Mill[a]	Tailings[b] (tons)	Comments
Hummingbird	CCSeg04	1926 - 1931	33,449	Hercules (Wallace)	26,125	Small producer
Marsh	CCSeg02	1908 - 1925	128,805	Marsh/Blackcloud	111,160	Ore was first produced at the Marsh Mine in 1908, continuing through 1925 (Mitchell and Bennett 1983b).
Sherman	CCSeg04	1927 - 1972	661,071	Sherman, Hercules (Wallace)	545,387	Ore was discovered in 1918 (SAIC 1993b) and production at the Sherman mine began from 1927 (Mitchell and Bennett 1983b). Lessees worked the mine after 1955.
Sisters	CCSeg05	1920 - 1929	472		68	The Sisters Mine began development as early as 1905 (Ransome and Calkins 1908) and produced less than 500 tons of ore during the 1920s.
Standard-Mammoth	CCSeg04	1887 - 1965	3,763,893	Standard-Mammoth	3,232,270	Originally separate mines, the Standard and Mammoth Mines were consolidated in 1904 and became known as the Standard-Mammoth Mine (Fahey 1978). Earliest production from either mine dates from 1887 (Mitchell and Bennett 1983b). Much of the ore was depleted by 1917 (SAIC 1993b); however, some production for the mine is recorded up until 1965 (Mitchell and Bennett 1983b).
Stanley	CCSeg03	1906 - 1942	1,459		1,443	Small producer

Table 2.1-1 (Continued)
Mines in Canyon Creek Watershed With Recorded Production

Mine	Segment	Production Years[a,b]	Ore[b] (tons)	Mill[a]	Tailings[b] (tons)	Comments
Star/Morning	CCSeg05	1925 - 1990	12,303,035	Star/Morning, Bunker Hill Complex, Hercules (Wallace), Hecla	9,164,183	Production from the Star-Morning vein began in 1895 on the eastern half of the vein from the Morning Mine, located on the South Fork. The Star Mine began producing ore from the western half of the vein in 1925. In 1958 the sand fraction of the tailings from the Star began to be used as backfill in the mine (SAIC 1993b). The Star Mine was the largest producer in Canyon Creek. Impoundment of tailings was first initiated in 1965 (SAIC 1993b) following the construction of two tailings ponds in lower Canyon Creek near Woodland Park. The Star Mine Tailings Ponds are located adjacent to and upstream from Woodland Park, where the floodplain of Canyon Creek widens. Six ponds are arranged end to end down the Canyon Creek floodplain. Ponds No. 1 and No. 2 were installed in 1965, No. 3 and 4 in 1970, No. 5 in 1975, and No. 6 in 1979 (SAIC 1993b). The ponds were closed in 1990; the No. 6 pond still receives discharge.

Table 2.1-1 (Continued)
Mines in Canyon Creek Watershed With Recorded Production

Mine	Segment	Production Years[a,b]	Ore[b] (tons)	Mill[a]	Tailings[b] (tons)	Comments
Tamarack-Custer	CCSeg04	1905 - 1979	1,973,630[a] to 2,819,472[d]	Tamarack-Custer, Hercules (Wallace), Frisco, Old Rex (16 to 1)	1,640,484[a] to 2,343,549	Workings associated with the Tamarack-Custer Mine are located in both Canyon Creek and Ninemile Creek. The Tamarack and Chesapeake Mine and the Custer Mine were consolidated in 1912 to form the Tamarack and Custer Consolidated Mining Company (Fahey 1978; Bennett 1997). In 1922, production on Canyon Creek began and all subsequent mining activity was conducted from Canyon Creek. Production continued through 1949 (SAIC 1993b) after which time most mining was done by lessees. Some production for the mine is recorded until 1979 (Bennett 1997).
Tiger-Poorman	CCSeg04	1901 - 1961	1,128,793	Tiger-Poorman, Hercules (Wallace)	915,535	The Tiger-Poorman Claims were located in 1884, and the Tiger and Poorman Mines were the first to produce ore in Canyon Creek, beginning around 1886 (SAIC 1993b). The mines were consolidated in 1895. Some production is recorded for the mine up until 1961 (Mitchell and Bennett 1983b).
Union	CCSeg05	Before 1905	5,168	Union	4,225	Production at this small producer ceased sometime before 1905 (Ransome and Calkins 1908).

[a]Source: Stratus 1999.
[b]Source: Ridolfi 1998.
[c]Includes production for Ambergris Mine in Ninemile Creek Watershed.
[d]Combined production for mines in Canyon Creek Watershed and Ninemile Creek Watershed.

Table 2.1-1 (Continued)
Mines in Canyon Creek Watershed With Recorded Production

Notes:
Blank cells indicate there was most likely no mill located on site, and ores were probably shipped elsewhere for milling. No records were found identifying the mill to which the ore was shipped. Estimated tailings produced by each mine were not necessarily disposed of within the reach where the ores were mined.

Table 2.1-2
Mills With Documented Operations in Canyon Creek Watershed

Mill	Segment	Operating Years	Ownership	Comments
Black Bear	CCSeg04	1888 - 1928	Black Bear Mining Company, Frisco Consolidated Mining Company, Bear Top Mining Company	
Dorn	CCSeg04	1940 - 1958	Tamarack and Custer	Tamarack and Custer constructed the Dorn Mill along Canyon Creek in 1940. In 1953, the mining activity was turned over to lessees. The mill closed in 1958 after all the known reserves in the Tamarack Mine had been mined (Quivik 1999).
Formosa	CCSeg05	1897 - 1948	Gies and Burke, Mutual Mines Development Company[b], Small Leasing Company[b]	The Formosa concentrator began operating in 1897 and operated only briefly. In 1909, the equipment was purchased and moved to a different site. In 1931, the Mutual Mines Development Company built a flotation mill on the Formosa property and operated it for approximately 6 months. In late 1942, the Small Leasing Company began operating the mill to rework tailings on Canyon Creek Tailings Association property. The Small Leasing Company ceased operations in 1948 (Quivik 1999).

Table 2.1-2 (Continued)
Mills With Documented Operations in Canyon Creek Watershed

Mill	Segment	Operating Years	Ownership	Comments
Frisco	CCSeg04	1890 - 1916	Helena and Frisco Mining Company, Exploration Company Ltd., Frisco Consolidated Mining Company, Federal Mining and Smelting Company, Tamarack and Custer Consolidated Mining Company	In late 1888, the Black Bear Mining Company built a concentrator along Canyon Creek just east of Gem. The mill closed in 1893. The Black Bear Property was deeded to the Frisco Consolidated Mining Company in 1900; the Black Bear Mill remained inactive. The Helena and Frisco Mining Company began operating a mill just downstream of the Black Bear Millsite in 1890. The Frisco Mill was in operation until 1901. In 1913, the Federal Mining and Smelting Company bought the Frisco Properties, including the Black Bear Mill and the nearby Frisco Mill. The Federal Mining and Smelting Company chose to remodel the nearby Black Bear Mill, which became known as the Frisco Mill. The new Frisco (old Black Bear) Mill operated until 1928; it was destroyed in 1937 (Quivik 1999).
Granite	CCSeg04	1888 - 1896	No record	Granite built its mill along Canyon Creek near Gem in 1888. The mill was shut down in 1896 and had been demolished by 1905 (Quivik 1999).
Hecla (Gem)	CCSeg04	1889 - 1948	Milwaukee Mining Company, Hecla Mining Company, Mammoth Mining Company[b]	The Milwaukee Mining Company constructed the Gem Mill in 1889. In 1897, the Gem Mill became the Hecla Mill. The mill concentrated ore until the Hecla Mine closed in July 1944; from 1944 to 1948, the Hecla Mill operated mainly on tailings (Quivik 1999).
Hercules[d]	CCSeg03	1905 - 1909	Hercules Mining Company	The Hercules Mining Company constructed its first mill along Gorge Gulch in 1905. Fire destroyed the mill in 1907. A new Hercules Mill was built just west of Wallace on the South Fork in 1911 (Quivik 1999).

Table 2.1-2 (Continued)
Mills With Documented Operations in Canyon Creek Watershed

Mill	Segment	Operating Years	Ownership	Comments
Hull Lease	CCSeg04	1928 - 1957	Hull Leasing Company	Hull worked the Frisco group of claims and treated the ore it mined at its own mill at Gem beginning in 1928. Hull's operations continued until 1957 (Quivik 1999).
Sherman	CCSeg04	1941 - 1959	Sherman Lead Company	The Sherman Lead Company constructed a mill at Burke in 1940. The mill was installed in the old Hercules rock house at the portal to the Hercules Mine. The Sherman Mill began operating in 1941 and continued operation until 1959 (Quivik 1999).
Standard and Mammoth (Union)	CCSeg05	1895 - 1917	Standard: Coeur d'Alene Mining and Concentrating Company (Union), Campbell and Finch, Green Hill Cleveland Mining Company[b], Federal Mining and Smelting Company[c] Mammoth: Mammoth Mining Company, Stewart Mining Company[b], Federal Mining and Smelting Company[c]	In 1895, the Union Mill began concentrating Standard's ore. By the end of 1895, the Union Mill was known as the Standard Mill. By 1900, the Mammoth Company had a mill 200 feet north of the Standard Mill. Around 1916, the Mammoth Mill became known as the Morning Mill No. 2 and operated only briefly after that. The Standard Mill was closed in December of 1917 and did not operate again (Quivik 1999).
Star	CCSeg05	1937 - 1990	Hecla Mining Company, Bunker Hill and Sullivan	The Star Mill was completed in July 1937 and operated almost continuously until 1990 (Quivik 1999).

Table 2.1-2 (Continued)
Mills With Documented Operations in Canyon Creek Watershed

Mill	Segment	Operating Years	Ownership	Comments
Tiger-Poorman	CCSeg02	1888 - 1897[a] 1897 - 1911	Carton, Seymour, Burke, Glidden, Consolidated Tiger and Poorman Mining Company, Buffalo Hump Mining Company, Empire State—Idaho Mining and Development Company, Federal Mining and Smelting Company, American Smelters Securities Company, Hercules Mining Company[b]	In 1888, the Tiger Mine was the first silver-lead mine in the district to open, and a concentrator was built that same year. The Poorman Mine was built shortly after the Tiger Mine, in 1888. In 1895, the Tiger and Poorman properties were consolidated. In 1896, a fire destroyed many of the buildings on the site. A new concentrator was built where the old Tiger Mill had been, and operations were in full production by early 1897. The mill was closed in 1907 when the orebodies appeared to be exhausted. Small quantities of ore continued to be produced by lessees. In 1909, the property was bought by another company and operated for about a year. The mill never operated again and the property was sold in 1920 (Quivik 1999).

[a]Operated as two separate mills, Tiger and Poorman, before consolidation into one mill.
[b]Leased to this company.
[c]Operated as Standard-Mammoth, operating both mills side by side.
[d]The Hercules Mining Company owned another mill not located on Canyon Creek.

Source: Quivik 1999.

Table 2.2-1
Slug Test Results for Canyon Creek Watershed

Location ID	Test ID	Apparent Hydraulic Conductivity (feet/day)[a]
CC418	R3	130
	R4	130
CC422	R1	[270]
	R2	[130]
CC440	R1	70
	R2	70
CC441	R1	70
	R2	70
CC453	R1	210
	R2	210
CC456	R1	210
	R2	220
CC459	R1	60
	R2	60
CC460	R3	170
	R4	150
CC462	R1	50
	R2	[50]
CC463	R1	[70]
	R2	[70]
CC464	R1	[90]
	R2	130
CC465	R1	50
	R2	20
CC467	R1	80
	R2	80
CC468	R1	[50]
	R2	[50]

[a]Hydraulic conductivity value represents average over the interval—saturated above bedrock.

Notes:
Hydraulic conductivity estimated by Bouwer and Rice method using AQTESOLV 2.5 (Bouwer and Rice 1976).
Values in brackets represent poor quality historical data.

Table 2.2-2
Water Quality Parameters in 1998 Wells in Gem and Mace Areas

Location ID	Sampling Date	Depth (feet below top of casing)	Temperature (°C)	pH	Specific Conductance (µS/cm)	Salinity (ppb)	Turbidity (NTUs)	Oxidation-Reduction Potential (millivolts)	Dissolved Zinc (µg/L)
CC401	12/04/98	21	4.1	6.89	0.043	0	21	258.7	33
CC402	12/03/98	32.3	6.7	6.69	0.163	0	0	335	NA
CC402	12/03/98	20	6.3	6.59	0.167	0	2	364	610
CC402	12/03/98	14	7.1	6.31	0.192	0	0	358	NA
CC403	12/03/98	23	5.8	7.28	0.154	0	0	254	NA
CC403	12/03/98	19	5.7	7.29	0.154	0	-7	196	76
CC403	12/03/98	13	5.7	7.27	0.153	0	-6	300	NA
CC409	12/03/98	30	4.4	6.9	0.131	0	-6	282	NA
CC409	12/03/98	20	4.6	6.89	0.131	0	-7	289	440
CC409	12/03/98	14	4	6.94	0.131	0	0	287	NA
CC414	12/04/98	21.5	4.4	6.46	0.131	0	0	296	NA
CC414	12/04/98	14	4.3	6.46	0.13	0	0	289	2,900
CC414	12/04/98	8	4.3	6.47	0.128	0	0	283	NA
CC415	12/04/98	19.5	5.3	6.74	0.401	0.01	0	269	8000
CC415	12/04/98	13.5	5.2	6.73	0.401	0.01	0	303	NA
CC417	12/04/98	13.5	4.8	7.14	0.127	0	0	280	NA
CC417	12/04/98	11.14	4.8	7.16	0.125	0	0	287.7	4,300
CC417	12/04/98	5.14	4.9	7.21	0.126	0	0	296.7	NA
CC418	12/04/98	40	4.6	6.85	0.097	0	0	70	4,400
CC418	12/04/98	20	4.5	6.8	0.1	0	0	50	4,300
CC418	12/04/98	14.5	4.3	6.74	0.1	0	0	40	NA
CC419	12/04/98	17	7.8	6.73	0.051	0	0	NR	37
CC422	12/05/98	15	6.7	6.56	0.292	0.01	0	309	34,000
CC422	12/05/98	9	6.6	6.84	0.291	0.01	0	341.3	34,000
CC423	12/05/98	13	6.9	6.65	0.088	0	0	22	NA
CC423	12/05/98	9.5	6.7	6.66	0.088	0	0	-11	1,100
CC431	12/03/98	95	8.3	7.35	0.044	0	201	-16	NA
CC431	12/03/98	78	8.5	6.34	0.041	0	147	-32	NA
CC431	12/03/98	72	7.9	6.61	0.036	0	155	-16	5
CC433	12/05/98	46	6.9	7.28	0.121	0	0	204	5.3
CC433	12/05/98	18	6.6	7.22	0.115	0	0	214	11
CC433	12/05/98	12	6.6	7.24	0.111	0	0	215	16
CC434	12/05/98	26.4	6.9	7.25	0.147	0	0	305	NA
CC434	12/05/98	10.5	6.8	7.27	0.147	0	0	290	NA
CC434	12/05/98	16.4	6.7	7.52	0.147	0	0	305	5 U

Table 2.2-2 (Continued)
Water Quality Parameters in 1998 Wells in Gem and Mace Areas

Location ID	Sampling Date	Depth (feet below top of casing)	Temperature (°C)	pH	Specific Conductance (µS/cm)	Salinity (pph)	Turbidity (NTUs)	Oxidation-Reduction Potential (millivolts)	Dissolved Zinc (µg/L)
CC437	12/03/98	134	8.1	5.73	0.022	0	276	20	NA
CC437	12/03/98	127	7.9	5.9	0.022	0	277	-3	3.5 J
CC440	12/05/98	18	6.3	6.86	0.0063	0	232	-85	1,100
CC440	12/05/98	29	8.7	6.98	0.067	0	374	-85	NA
CC440	12/05/98	11.5	6.2	6.86	0.058	0	105	-73	NA
CC441	12/05/98	28	8.5	5.92	0.12	0	6	342	NA
CC441	12/05/98	15	8.4	5.87	0.118	0	7	356	1,200
CC441	12/05/98	9	8	5.87	0.113	0	5	365	NA
CC452	12/05/98	7.5	7	6.34	0.287	0.01	0	345	NA
CC452	12/05/98	43	7.1	6.34	0.269	0.01	0	305	NA
CC452	12/05/98	13.5	7	6.48	0.275	0.01	0	320	5,400

Notes:
µS/cm - microsiemen per centimeter
NR - not recorded
NTU - nephelometric turbidity unit
pph - part per hundred
NA - not available
U - not detected
J - estimated value
µg/L - micrograms per liter

Table 2.2-3
Water Chemistry Parameters in 1998 Wells in Woodland Park, Gem, and Mace Areas

Location ID	Sampling Date	Depth (feet below top of casing)	Chloride (µg/L)	Sulfates (µg/L)	Sulfides (µg/L)
CC401	12/04/98	21	1,000 U	7,000	1,000 U
CC402	12/03/98	20	5,000	30,000	1,000 U
CC403	12/03/98	19	1,000 U	16,000	1,000 U
CC409	12/03/98	20	1,000 U	15,000	1,000 U
CC414	12/04/98	14	1,000 U	29,000	1,000 U
CC415	12/04/98	19.5	2,000	120,000	1,000 U
CC417	12/04/98	17.5	2,000	26,000	1,000 U
CC417	12/04/98	17.5	1,000	25,000	1,000 U
CC418	12/04/98	40	1,000 U	23,000	1,000 U
CC418	12/04/98	20	1,000 U	23,000	1,000 U
CC419	12/04/98	17	1,000 U	3,000	1,000 U
CC419	12/04/98	11	1,000 U	4,000	1,000 U
CC422	12/05/98	15	3,950	97,900	200 U
CC422	12/05/98	9	3,860	97,800	200 U
CC423	12/05/98	9.5	342	25,100	200 U
CC431	12/03/98	74	1,000 U	5,000	1,000 U
CC431	12/03/98	72	1,000 U	5,000	1,000 U
CC432	12/08/98	32	1,000 U	10,000	1,000 U
CC433	12/05/98	46	420	13,300	200 U
CC433	12/05/98	18	467	12,800	200 U
CC433	12/05/98	12	300	13,000	200 U
CC434	12/05/98	16.5	522	25,300	200 U
CC437	12/03/98	127	1,000 U	4,000	1,000 U
CC440	12/05/98	18	505	13,700	200 U
CC441	12/05/98	15	7,570	20,700	200 U
CC449	12/07/98	36	1,000 U	6,000	1,000 U
CC449	12/07/98	19	1,000 U	6,000	1,000 U
CC449	12/07/98	13	1,000 U	6,000	1,000 U
CC451	12/07/98	37	2,000	12,000	1,000 U
CC451	12/07/98	15.5	2,000	12,000	1,000 U
CC451	12/07/98	9.5	2,000	12,000	1,000 U
CC452	12/05/98	13.5	20,500	53,400	320
CC453	12/07/98	37	4,000	120,000	1,000 U
CC453	12/07/98	15.5	4,000	120,000	1,000 U
CC453	12/07/98	9.5	4,000	120,000	1,000 U

Table 2.2-3 (Continued)
Water Chemistry Parameters in 1998 Wells in Woodland Park, Gem, and Mace Areas

Location ID	Sampling Date	Depth (feet below top of casing)	Chloride (µg/L)	Sulfates (µg/L)	Sulfides (µg/L)
CC456	12/09/98	28	1,630	42,800	200 U
CC456	12/09/98	14	1,740	42,500	200 U
CC456	12/09/98	8	1,750	42,300	200 U
CC459	12/08/98	45.7	1,000 U	210,000	1,000 U
CC459	12/08/98	22.8	1,000 U	200,000	1,000 U
CC459	12/08/98	16.8	1,000 U	220,000	1,000 U
CC460	12/07/98	47.6	2,000	30,000	1,000 U
CC460	12/07/98	13.8	2,000	27,000	1,000 U
CC460	12/07/98	7.8	2,000	24,000	1,000 U
CC462	12/08/98	13	1,000	140,000	1,000 U
CC462	12/08/98	7	1,000	140,000	1,000 U
CC463	12/07/98	63	2,000	97,000	1,000 U
CC463	12/07/98	13	2,000	94,000	1,000 U
CC463	12/07/98	7	2,000	88,000	1,000 U
CC464	12/08/98	63	2,000	270,000	1,000 U
CC464	12/08/98	24	2,000	250,000	1,000 U
CC464	12/08/98	18	2,000	250,000	1,000 U
CC465	12/08/98	51	1,000 U	31,000	1,000 U
CC465	12/08/98	15	1,000 U	30,000	1,000 U
CC465	12/08/98	9	1,000 U	37,000	1,000 U
CC467	12/09/98	42.5	4,870	76,800	200 U
CC467	12/09/98	13	4,940	76,800	200 U
CC467	12/09/98	7	4,910	76,900	200 U
CC468	12/08/98	11	4,000	36,000	1,000 U
CC468	12/08/98	5	4,000	37,000	1,000 U
CC469	12/08/98	13.8	2,000	43,000	1,000 U
CC469	12/08/98	7.8	1,000	43,000	1,000 U
CC481	12/09/98	17.5	467	58,000	200 U
CC481	12/09/98	17.5	492	60,800	200 U

Note:
U - not detected

Table 2.2-4
Water Quality Parameters in Pre-1998 Wells in Woodland Park Area

Sampling Location[a]	Sampling Date	pH	Specific Conductance (µS/cm)	Temperature (°C)
WP-1 (CC1490) Well Depth = 15.0 ft bgs	04/02/93	4.62	0.369	5.7
	05/26/93	4.7	0.315	10.6
	09/26/93	5.5	0.270	13.0
	09/95	5.27	0.220	13.0
	04/96	5.03	0.836	5.6
	11/06/96	5.6	0.190	9
	04/18/97	4.97	0.160	6.0
	10/15/97	4.49	0.195	10.5
WP-2 (CC1491) Well Depth = 19.5 ft bgs	04/02/93	5.36	0.226	8.5
	05/26/93	5.63	0.202	12.3
	05/25/94	5.8	0.251	12.7
	04/96	6.0	0.619	5.1
	11/06/96	6.3	0.138	9
	04/18/97	5.5	0.155	7.0
	10/14/97	5.35	0.180	7.3
WP-3 (CC1492) Well Depth = 25.0 ft bgs	04/02/93	5.01	0.268	8.6
	05/26/93	5.19	0.255	10.9
	04/96	6.27	0.982	6.1
	11/06/96	5.8	0.250	15
	04/17/97	6.3	0.335	10
	10/14/97	5.01	0.282	11.1
WP-4 (CC1493) Well Depth = 33.5 ft bgs	04/02/93	5.55	0.323	9.3
	05/26/93	6.32	0.361	10.7
	09/95	6.99	0.333	10.5
	04/96	6.73	1.347	7.0
	11/06/96	6.9	0.320	15
	04/17/96	5.4	0.250	9.5
	10/14/97	5.68	0.355	10.1

Table 2.2-4 (Continued)
Water Quality Parameters in Pre-1998 Wells in Woodland Park Area

Sampling Location	Sampling Date	pH	Specific Conductance (µS/cm)	Temperature (°C)
WP-5 (CC1494) Well Depth = 10.5 ft bgs	04/02/93	4.52	0.213	6.5
	05/26/93	4.79	0.183	12.6
	09/95	5.19	1.664	14.2
	04/96	5.32	0.620	6.0
	11/06/96	6.6	0.075	12
	04/17/97	6.3	0.090	9.5
T-1 (CC1495)[b]	05/27/94	5.4	0.232	11.3
T-2 (CC1496) Well Depth = 8.5 ft bgs	09/26/93	5.4	0.094	12.0
	05/25/94	6.7	0.049	10.7
	09/95	6.59	0.086	15.0
	04/96	6.18	0.699	6.18
	10/28/96	5.7	0.170	10.5
	04/17/97	4.4	0.209	6.1
	10/14/97	5.17	0.091	9.0
T-3 (CC1497) Well Depth = 8.15 ft bgs	05/26/94	4.7	0.268	11.0
	09/95	4.61	0.629	7.0
	04/96	5.0	0.629	7.0
	11/11/96	5.29	0.170	9.1
	04/17/97	4.9	0.132	8.8
	10/14/97	4.00	0.171	8.7
T-4 (CC1498) Well Depth = 5.2 ft bgs	09/26/93	5.8	0.360	14.0
	05/26/94	5.2	0.322	12.7
	09/95	4.87	0.312	15.7
	04/96	4.71	1.254	5.1
	11/06/96	6.3	0.100	11
	04/18/97	5.4	0.101	4.5
	10/15/97	5.08	0.150	12.0

Table 2.2-4 (Continued)
Water Quality Parameters in Pre-1998 Wells in Woodland Park Area

Sampling Location[a]	Sampling Date	pH	Specific Conductance (µS/cm)	Temperature (°C)
T-5 (CC1499) Well Depth = 5.5 ft bgs	09/26/93	5.8	0.285	15.0
	05/26/94	5.4	0.289	13.1
	09/95	5.4	0.225	15.2
	04/96	6.02	0.973	6.0
	11/06/96	5.62	0.130	7.5
	04/18/97	6.0	0.090	7.5
	10/15/97	5.05	0.130	9.5
T-6 (CC1500)[b]	09/26/93	5.9	0.262	12.0
	05/26/94	6.0	0.229	11.4
T-7 (CC1501) Well Depth = 10.45 ft bgs	09/26/93	6.1	0.236	13.0
	05/26/94	5.8	0.230	13.3
	09/95	5.67	1.748	14.4
	04/96	6.26	0.736	7.4
	11/06/96	6	0.270	15
	04/18/97	5.4	0.185	6.9
	10/14/97	4.97	0.218	12.5
E-5 (CC1502)[b]	05/26/94	7.5	0.099	8.9
E-16 (CC1503)[b]	05/26/94	NR	NR	NR
CM-1 (CC1504) Well Depth = 13.5 ft bgs	09/95	5.20	0.775	12.9
	04/96	7.59	0.210	6.9
	10/28/96	5.7	0.055	9.8
	04/16/97	5.1	0.040	8.3
	10/13/97	5.08	0.079	10.3
CM-2 (CC1505) Well Depth = 7.5 ft bgs	09/95	5.48	1.336	16.5
	04/96	5.9	0.295	6.1
	10/28/96	6.1	0.125	9.1
	04/16/97	5.4	0.070	7.9
CM-3 (CC1506) Well Depth = 9.3 ft bgs	09/95	3.46	1.842	17.7
	04/96	5.5	0.820	5.8
	10/28/96	5.64	0.405	11
	04/16/97	5.1	0.235	5.5

Table 2.2-4 (Continued)
Water Quality Parameters in Pre-1998 Wells in Woodland Park Area

Sampling Location	Sampling Date	pH	Specific Conductance (µS/cm)	Temperature (°C)
	10/13/97	4.81	0.291	11.4
CM-4	09/95	5.60	4.230	14.7
(CC1507)	10/18/95	5.55	4.900	7.4
Well Depth =	04/96	6.10	1.517	6.2
7.0 ft bgs	10/28/96	5.91	0.180	9
	04/17/97	5.4	0.188	7.5
	10/13/97	5.32	0.222	8.9
CM-5	09/95	5.61	1.311	19.8
(CC1508)	04/96	6.6	0.509	7.0
Well Depth =	10/28/96	5.91	0.295	8
5.5 ft bgs	04/17/97	5.9	0.112	12.0
	10/13/97	5.24	0.289	8.9
CM-6	09/95	5.72	0.970	16.4
(CC1509)	04/96	6.7	0.749	6.0
Well Depth =	11/06/96	5.8	0.330	13
9.0 ft bgs	04/17/97	5.5	0.163	6.2
	10/13/97	5.11	0.482	11.3
CM-7	09/95	4.64	1.672	13.9
(CC1510)	04/96	5.24	0.620	8.2
Well Depth =	11/06/96	5.5	0.095	10
6.6 ft bgs	04/17/97	4.7	0.109	8.5
	10/14/97	3.77	0.100	8.7
CM-8	09/95	5.59	2.270	18.6
(CC1511)	04/96	6.85	1.167	9.01
Well Depth =	11/06/96	6.6	0.255	12
8.5 ft bgs	04/17/97	5.7	0.210	11.0
	10/14/97	5.48	0.226	10.1
CM-9	09/95	6.20	1.500	19.0
(CC1512)	04/96	6.9	0.261	7.6
Well Depth =	11/06/96	5.8	0.240	12
6.0 ft bgs	04/17/97	5.6	0.094	12

Table 2.2-4 (Continued)
Water Quality Parameters in Pre-1998 Wells in Woodland Park Area

Sampling Location[a]	Sampling Date[b]	pH	Specific Conductance (µS/cm)	Temperature (°C)
	10/14/97	5.35	0.160	10.0
CM-10 (CC1513) Well Depth = 6.0 ft bgs	09/95	5.10	0.323	15.3
	04/96	5.59	1.135	8.2
	11/06/96	6.2	0.262	12
	04/18/97	5.4	0.250	7
	10/15/97	5.65	0.330	11.0
CM-11 (CC1514) Well Depth = 7.0 ft bgs	09/95	5.93	0.217	12.0
	04/96	5.06	0.787	7.0
	11/06/96	5.9	0.500	12
	04/18/97	5.4	0.200	7.0
	10/14/97	4.84	0.370	10.3
CM-12 (CC1515) Well Depth = 7.0 ft bgs	09/95	5.64	0.274	13.6
	04/96	5.79	0.783	6.3
	11/06/96	6.2	0.180	9
	04/18/97	5.8	0.140	7
	10/15/97	5.38	0.220	12.0

[a]URS location number is in parentheses.
[b]Well construction information not available.

Notes:
Groundwater samples were filtered through a 0.45-micron filter before data were recorded.
µS/cm - microsiemen per centimeter
NR - not recorded
ft bgs - feet below ground surface

Source: MFG 1998.

Table 2.3-1
Summary of Stream Discharge Measurements From Project Database for Segments CCSeg01 Through 05

Segment Name	Site Location	Measured By	No. of Readings	Beginning Date	Ending Date	Minimum Discharge (cfs)	Maximum Discharge (cfs)
CCSeg01	CC 272	URS	1	11/10/97	11/10/97	2.36	2.36
CCSeg01	CC 289	URS	1	05/15/98	05/15/98	77.4	77.4
CCSeg02	CC 1	MFG	2	05/17/91	10/05/91	2.63	95.7
CCSeg02	CC 2	IDEQ, MFG, USGS	42	05/18/91	09/13/95	3.56	248
CCSeg02	CC 273	URS	2	11/10/97	05/15/98	20.1	130
CCSeg02	CC 274	URS, USGS	10	11/10/97	06/15/99	5.6	292
CCSeg02	CC 275	URS	1	11/10/97	11/10/97	0	0
CCSeg02	CC 290	URS	1	05/15/98	05/15/98	194	194
CCSeg02	CC 410	URS	1	11/12/98	11/12/98	5.05	5.05
CCSeg03	CC 392	MFG, URS	4	05/18/91	11/12/98	0.255	12
CCSeg04	CC 15	MFG, USGS	12	05/17/91	06/05/98	11.9	409
CCSeg04	CC 276	IDEQ, MFG, URS, USGS	46	05/18/91	08/30/99	5	127
CCSeg04	CC 277	MFG, URS	5	05/18/91	11/12/98	7.99	165
CCSeg04	CC 278	IDEQ, MFG, URS, USGS	43	05/17/91	05/14/98	6.19	264
CCSeg04	CC 279	MFG, URS	4	05/17/91	11/12/98	10.5	99.1
CCSeg04	CC 280	MFG, URS, USGS	9	05/17/91	11/12/98	10.6	372
CCSeg04	CC 281	MFG, URS	4	05/17/91	05/14/98	11.8	309
CCSeg04	CC 282	IDEQ, URS, USGS	42	10/18/95	05/24/99	11.3	310
CCSeg04	CC 291	IDEQ, URS, USGS	58	08/16/93	03/08/99	8.03	328
CCSeg04	CC 411	URS	1	11/12/98	11/12/98	6.57	6.57
CCSeg04	CC 420	URS	1	11/12/98	11/12/98	8.38	8.38
CCSeg04	CC 421	URS	1	11/12/98	11/12/98	8.36	8.36
CCSeg04	CC 425	URS	1	11/12/98	11/12/98	9.79	9.79
CCSeg04	CC 436	URS	2	11/12/98	11/13/98	8.52	12.2
CCSeg04	CC 438	URS	1	11/12/98	11/12/98	9.88	9.88
CCSeg04	CC 439	URS	1	11/13/98	11/13/98	13.6	13.6
CCSeg04	CC 443	URS	1	11/13/98	11/13/98	20.8	20.8
CCSeg04	CC 444	URS	1	11/13/98	11/13/98	20.3	20.3
CCSeg04	CC 484	URS	1	11/13/98	11/13/98	24.9	24.9
CCSeg04	CC 485	URS	1	11/13/98	11/13/98	17.4	17.4

Table 2.3-1 (Continued)
Summary of Stream Discharge Measurements From Project Database for Segments CCSeg01 Through 05

Segment Name	Site Location	Measured By	No. of Readings	Beginning Date	Ending Date	Minimum Discharge (cfs)	Maximum Discharge (cfs)
CCSeg04	CC 486	URS	1	11/13/98	11/13/98	23.4	23.4
CCSeg05	CC 17	MFG, URS	2	10/05/91	11/14/98	13.4	19.2
CCSeg05	CC 23	MFG	5	05/15/91	10/05/91	16.3	398
CCSeg05	CC 283	URS	2	11/09/97	05/15/98	32.8	156
CCSeg05	CC 284	IDEQ, MFG, URS, USGS	49	05/17/91	11/09/97	7.12	271
CCSeg05	CC 285	IDEQ, MFG, URS, USGS	44	05/17/91	08/30/99	5	417
CCSeg05	CC 286	MFG, URS	4	10/05/91	11/14/98	16.2	187
CCSeg05	CC 287	IDEQ, MFG, URS, USGS	93	10/05/91	03/08/99	11.4	668
CCSeg05	CC 288	URS, USGS	17	11/09/97	08/30/99	5	384
CCSeg05	CC 454	URS	1	11/13/98	11/13/98	22.2	22.2
CCSeg05	CC 455	URS	2	11/13/98	11/14/98	21	25.8
CCSeg05	CC 457	URS	1	11/14/98	11/14/98	25.2	25.2

Note:
cfs - cubic feet per second

Table 2.3-2
Estimated Recurrence Intervals for Canyon Creek Based on Placer Creek Annual Peak Discharge

Recurrence Interval (Years)	Estimate of Discharge Annual Frequency Peak Flow 30 Year Period of Record[a] (cfs)	Lower 95 Percent Confidence Interval (cfs)	Upper 95 Percent Confidence Interval (cfs)
2	544	441	676
5	955	779	1264
10	1308 (1100)	1014	1808
25	1793	1352	2675
50	2219 (2400)	1631	3469
100	2675 (3250)	1911	4395

[a]Values in parentheses are results of the Flood Insurance Study for the City of Wallace, Idaho (FIA 1979).

Note:
cfs - cubic feet per second

Table 2.3-3
Precipitation Summary and Discharge Comparison for Water Year 1999 at the WRCC, Wallace Station, Woodland Park, Idaho—NOAA Cooperative Station 109498

Climate Indicators	Monthly Totals												Annual
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Total Precipitation (in.)	1.2	9.7	6.9	4.7	6.9	3.5	0.7	0.9	1.8	0.2	3.0	0.3	39.8
Total Snowfall (in.)	0.0	6.3	8.7	18.9	26.4	21.3	0.6	0.0	0.0	0.0	0.0	0.0	82.2
Average Precipitation for Period of Record (in.)	2.9	4.9	5.2	5.0	3.9	3.4	2.8	2.7	2.6	1.3	1.4	1.9	37.7
Average Snowfall for Period of Record (in.)	0.5	8.3	22.6	24.0	15.0	10.5	2.5	0.3	00	0.0	0.0	0.0	83.7
Mean Monthly Discharge (cfs) (Canyon Creek at Wallace)	13.2	18.7	21.6	23.9	20.1	50.0	75.4	158.9	201.4	81.9	30.4	17.7	59.5

Note:
cfs - cubic feet per second

3.0 SEDIMENT TRANSPORT PROCESSES

Sediment derived in Canyon Creek is transported through the system and into the South Fork. Potential sediment sources in Canyon Creek are mine waste, rock debris situated adjacent to channels, channel bed sediment, bank erosion, and road drainage. Based on USGS sediment transport and stream discharge data, approximately 1,350 tons of sediment were transported out of Canyon Creek in water year 1999. Based on estimates of historical surface water and sediment discharge, this was below average for the period 1990 to 1999. In this discussion, the available information, analyses, and likely sediment sources are identified.

3.1 AVAILABLE INFORMATION

One year of sediment transport gaging data is available for Canyon Creek. The USGS installed a stream gaging station (Canyon Creek above the Mouth at Wallace, Idaho, number 12413125) and began reporting hydrologic data for water year 1999 (October 1, 1998 through September 31, 1999) (USGS 2000a). Associated with this gage, the USGS established suspended and bedload sampling locations (USGS 2000b). Data from seven suspended load and five bedload sampling events are available from three storm events. The suspended load data were further divided into sand and silt fractions. The suspended and bedload sampling events were completed over a range of stream discharges to establish a rating curve relating sediment discharge to stream discharge. In addition, sampling was completed on both the rising and falling limbs of high water events to examine the transport during these differing conditions (the hysteresis effect). Instantaneous stream discharge was recorded at the time of sampling for use in rating curve development.

Mean daily discharge estimates prior to 1999 have been calculated as outlined in Section 2.3. These estimates were developed based on relationships between the discharge patterns in Canyon Creek as compared to Placer Creek for which discharge data prior to 1999 has also been collected.

In addition to the gaging data, historical and current aerial photography is available. For Canyon Creek, 1998 photographs (URS and CH2M HILL 1999), 1991 photographs by U.S. Department of Agriculture (USDA) (USDA 1991), and 1984 photographs by USDA (USDA 1984) were reviewed.

3.2 ANALYSES

3.2.1 USGS Sediment Transport Data

The USGS sediment transport data were analyzed in general accordance with the U.S. Army Corps of Engineers (USACE) guidance manual for sedimentation investigations (USACE 1989). Sediment rating curves were developed by relating measured stream discharge to measured sediment discharge. These curves were integrated with the stream discharge for water year 1999 and estimates of historical stream discharge to produce estimates of annual sediment yield for Canyon Creek. These sediment transport data were further examined to delineate threshold discharges where different particle size classes become mobile.

The USGS sediment discharge station on Canyon Creek is located near the confluence with the South Fork Coeur d'Alene River, near the downstream end of CCSeg05. As such, these data represent the sediment yield for the entire Canyon Creek Watershed.

The suspended sediment data are presented in Figure 3.2-1, with rating curves established for the sand and fine fractions. The stream channel discharge presented is the instantaneous discharge noted at the time of sampling. The correlation analysis used to establish the curves is a power function that calculates the least squares fit through the points. The grain size break between sand and fines is 63 microns.

The relationships shown in Figure 3.2-1 were integrated with the mean daily discharge data from USGS gage 12413125, Canyon Creek at Wallace, to obtain mean daily suspended sediment discharge for water year 1999. Like the original data, the sand and fines fractions were calculated separately and summed to calculate the total suspended sediment discharge. Cumulative sediment discharge for water year 1999 year was calculated by summing the mean daily sediment discharges. The results are presented in Figures 3.2-2 through 3.2-4. With a drainage area of approximately 21.9 square miles, the total suspended sediment yield for Canyon Creek for water year 1999 was approximately 60 tons per year per square mile. Of that, approximately 23 tons were sand and 37 tons were fines.

A similar analysis was completed for the bedload sediment data by the USGS (2000b). Rating curves and relationship for bedload transport in Canyon Creek are presented. As with the suspended sediment data, the relationship for bedload was integrated with the mean daily discharge hydrograph to obtain daily and cumulative bedload discharge for water year 1999. These results are presented in Figure 3.2-5. Annual bedload sediment yield was approximately 2 tons per year per square mile for Canyon Creek in water year 1999.

Summing the total suspended load and bedload sediment gives the total sediment yield for water year 1999 as approximately 62 tons per square mile, or a total of approximately 1,400 tons for the watershed. Water year 1999 appears to be typical, from a water and snow budget perspective, as discussed in Section 2.3; however, sediment yields can vary significantly from year to year based on hydrologic conditions, sediment inputs, changing land use, and other conditions.

As indicated by the USGS data, the majority of sediment transport occurs during high flow events. Much larger discharge events are likely to occur in Canyon Creek (both past and future events) than were observed during water year 1999. During these larger events, increased sediment load should be expected. In fact, peak discharges predicted by the Flood Insurance Study, for the mouth of Canyon Creek are 1,100 cfs for a 10-year event and 3,250 cfs for a 100-year event (FIA 1979).

Review of Figures 3.2-2 through 3.2-5 indicates the majority of sediment transport occurred approximately from May 19 to July 18, 1999. Two distinct peaks of high sediment discharge are evident in the figures. Two other distinct periods of increased sediment discharge occurred approximately from March 20 to 30, 1999 and April 19 to May 9, 1999. High temperatures, rainfall, and snowmelt caused large stream discharges during these periods, as discussed in Section 2.3. These high stream discharges mobilized and transported the vast majority of the sediment yield for water year 1999. Similar high sediment transport rates would be expected on an annual basis as snowmelt in the upper watershed mobilizes and transports sediment through the system.

To estimate sediment transport in years before water year 1999, the estimates of discharge based on Placer Creek data, described in Section 2.3, were integrated with the sediment transport relationships developed for Canyon Creek water year 1999 data. The results are presented in Table 3.2-1. These estimates may be high because the discharge estimates for Canyon Creek from Placer Creek provided in Section 2.3 overestimate discharge by 20 percent for the peak discharge measured in water year 1999. In addition, extrapolation of the sediment rating curves to stream discharges greater than discharges that were used to develop the rating curve were employed.

Nevertheless, a wide range of sediment transport rates is indicated. In this type of analysis, the quantities of sediment transported are directly related to the magnitude and duration of stream discharge. Years with high peak discharge and long duration will produce more sediment than years with low discharge and short duration. This information is presented in Figures 3.2-6 through 3.2-8. These figures present estimates of cumulative sediment transport (for fines, sand

and bedload, respectively) through time, for example water years from 1980 to 1999. A wide range of sediment transport rates are estimated and in general most of the transport occurs between February and June during large stream discharges.

To identify potential thresholds of sediment transport based on the USGS data, calculated estimates of daily sediment discharge for sand, fines, and bedload were examined. For each daily estimate and size class, for water year 1999, the percentage of total annual sediment discharge was calculated. These values were plotted against stream discharge and percent of maximum daily discharge for water year 1999 as shown in Figure 3.2-9. As would be expected, this figure indicates sediment discharge increases with increasing stream discharge. For both sand and fines, rapid increases in sediment discharge occur at stream discharges of approximately 100 to 110 cfs, 240 to 250 cfs, and 370 to 390 cfs for water year 1999. Figure 3.2-9 also indicates that bedload transport steadily increases with increasing stream discharge. Although this analysis is based on a few measurements of sediment transport, it can provide some guidance to discrete stream discharges where increased sediment transport may be expected.

In addition, Figure 3.2-9 suggests that approximately 60 percent of the total annual sediment discharge from Canyon Creek was fines, 37 percent was sand, and 3 percent was bedload.

McBain and Trush (2000) conducted a study in the Woodland Park area (and other areas) to evaluate potential stream flow thresholds at which suspended and bedload sediment transport would occur. The results of their study indicated that fine sediment transport occurred around 25 cfs with increasingly coarser sediment transport occurring at 100 cfs and between 250 and 350 cfs. Initial transport of bedload started between 170 and 200 cfs. The findings of this study are consistent with estimated sediment transport curves in the RI. This information can help identify stream flows at which increases in lead loading (transported as a particulate) in surface water can be expected.

3.2.2 Channel Classification

Rosgen (1996) proposed a classification that delineates channel types based on plan-view morphology, cross-section morphology, channel sinuosity, channel slope, and bed features to provide a broad level delineation. Aerial photograph and topographic map interpretation can be used for this Level 1 type of classification. The Rosgen methodology builds from this broad classification when combined with more detailed information. The Rosgen Level 1 classification was used for this study to identify broad reach-level channel morphologies.

Electronic USGS 7-½-minute quadrangle maps containing three-dimensional topographic data were analyzed using AutoCAD Land development software. Plots of channel profile and slope were produced for each segment of Canyon Creek (see Figures 3.2-10 through 3.2-14). In general, the divisions between segments were established based on changes in channel type or other morphologic feature. As such, each segment contains one or two channel types. The channel type was determined based on channel slope and review of aerial photographs from 1998.

Channel stationing was established at 100-foot increments upstream from the confluence of Canyon Creek with the South Fork for ease of locating specific features. This stationing is indicated on Figures 3.2-10 to 3.2-19. This stationing is approximate. More detailed stationing and survey which would be needed for precise system locating.

Four Rosgen stream types occur in the Canyon Creek watershed: "Aa+," "A," "B," and "C." The four channel types and the channel classification mapping effort are summarized below.

"Aa+" streams are very steep, greater than 10 percent, well entrenched, and laterally confined. Sediment supply is often high due to the high energy, steep channel slopes and narrow channel cross sections. Bedforms associated with this channel type include waterfalls, cascades, and step-pools. Debris flows often initiate in "Aa+" type channels. In Canyon Creek, structural control from joints, faults, or bedding may influence the locations of "Aa+" type channels.

"A" stream types are similar to "Aa+" in that similar bedforms and channel characteristics are common to both types; however, "A" stream types have slopes which range from 4 to 10 percent. Generally, "A" stream types have high sediment transport potential with little in-channel sediment storage capacity due to the channel slope. Large woody debris can play a major role in the bedform and channel stability in "A" type streams.

"B" stream types are moderately steep to gently sloped channels, 2 to 4 percent. Faults, joints, contacts often influence "B" type channels by restricting the development of wide floodplains. Stream erosion rates, aggregation and degradation rates are generally low. Lateral movement of "B" type channels is typically low. Rapids and scour pools are typical features in type "B" channels.

"C" stream types generally are located in valleys constructed from alluvial deposition, with well-developed floodplains. Primary morphologic features of the "C" stream type are the sinuous low relief channel, and the well-developed floodplain built sediment derived from the river. Lateral migration, aggregation and degradation rates in "C" type channels are dependent on the stability of the banks, discharge and sediment supply from upstream. "C" type channels may be significantly altered by changes in bank stability, discharge, or sediment supply.

The channel types within Canyon Creek are identified on Figures 3.2-15 through 3.2-19. The steep channels in CCSeg03 and the middle reach of CCSeg01 contain "Aa+" channel types. The upper and lower portion of CCSeg01 and the upper portion of CCSeg02 of contain "A" channels. All of CCSeg04, the lower portion of CCSeg02 and the upper portion of CCSeg05 contain "B" channels. Almost all of CCSeg05 contains "C" channels. Based on this classification and the generalizations stated above, areas which have the highest potential for sediment (and metals) entrainment into the surface water are the A and Aa+ stream types. The "B" type channels in CCSeg02, CCSeg04, and CCSeg05 will not contribute as much sediment to the system as the A and Aa+ channels; however sediment input from soil and rock debris piles may be significant. In addition, some of these "B" channels have historical aerial photographic evidence of rapid lateral migration. If remedial measures already completed do not control lateral migration, these reaches may contribute additional sediment. The "C" channels of CCSeg05 are likely to have both depositional and erosional features. As bars develop from deposition, erosion of previously deposited sediment may occur. Recent stabilization efforts may reduce this problem.

3.2.3 Channel Descriptions

The 1998 set of aerial photographs by URSG and CH2M HILL, the 1991 and 1984 set by USDA, and the topographic maps and profiles presented in Figures 3.2-1 through 3.2-19 were reviewed to further describe Canyon Creek. This review and interpretation focused on morphologic features indicating stream instability, channel migration, channel aggregation or degradation and other features that may contribute sediment to the system.

3.2.3.1 CCSeg01 (Station 430+00 to 550+00)

CCSeg01 has approximately 12,000 feet (2.3 miles) of mapped channel as indicated in Figure 3.2-15. Channel slope varies from 5 to 7 percent (Figure 3.2-10). Photographic coverage reviewed from 1984 and 1991 extended to station 510+00. Through this section, Canyon Creek flows through a broad valley bottom over 200 feet wide. The valley bottom is vegetated with conifers that obscure view of the channel throughout the reach. Significant sediment sources were not noted in the photographs reviewed. Likely sediment sources in this reach and segment include remobilization of channel bed sediment, and minor bank erosion.

3.2.3.2 CCSeg02 (Station 360+00 to 420+00)

Canyon Creek has approximately 6,000 feet (1.1 miles) of mapped channel in CCSeg02, Figure 3.2-16. Channel slope through this segment ranges from 1 to 90 percent (Figure 3.2-11). Aerial photography of CCSeg03 from 1998 is limited to station 360+00 to 412+00; description of Canyon Creek upstream of station 412+00 is based on review of 1984 and 1991 photographs. The channel through CCSeg02 is constrained by roads and hillslopes. Several rock debris deposits on the hillslopes surrounding Canyon Creek and adjacent to Canyon Creek are likely sources of sediment in this segment. Additional sources are remobilization of channel bed sediment.

Canyon Creek, from station 360+00 to 392+00, is constrained by a road and steep valley walls in a valley bottom approximately 100 feet wide. Channel slope ranges from 3.5 to 5.5 percent. Abundant vegetation surrounding the channel is apparent in the 1998 photographs as compared to downstream segments. From station 363+00 to 370+00, the Marsh Mine site is located to the south of Canyon Creek. Debris piles from this working surround the site. A rock debris deposit is located on the steep hillslope above the Marsh Mine. Rock debris from the Gertie Mine is located adjacent to Canyon Creek from Station 374+00 to 378+00. Likely sediment sources in this reach include remobilization of channel bed sediment, and sediment derived from the mine sites and rock debris deposits scattered through the reach.

From station 392+00 to 420+00, the Canyon Creek Valley widens to about 200 feet. The channel slope ranges from 3.5 to 8 percent. Trees obscure the channel in the photographs reviewed. Several small rockfalls on the south facing slopes above Canyon Creek may terminate in the channel from station 390+00 to 410+00. Several disturbances or rock debris deposits are located on a ridgeline above Canyon Creek at Station 404+00. The Canyon Creek Rockpit is located north of the channel from station 402+00 to 411+00. Rock debris deposits from Ajax Number 3 are set back from the creek approximately 500 feet at the base of the valley wall. Likely sediment sources in this reach include remobilization of channel bed sediment, and sediment derived from the various exposed rock deposits identified above.

3.2.3.3 CCSeg03 (Gorge Gulch)

Gorge Gulch has approximately 7000 feet (1.3 miles) of mapped channel in CCSeg03 (Figure 3.2-17). The channel slope ranges from 10 to 30 percent (Figure 3.2-12). The high gradient of this channel likely provides efficient transport of sediment supplied to the channel. The channel through this segment is confined by steep valley walls with several deposits of rock debris located adjacent to the ravine bottom. Numerous logging and other dirt roads cross the hillslopes surrounding the channel. Sediment sources in CCSeg03 include remobilization of channel bed sediment, sediment derived from rock waste piles, and sediment derived from road drainage.

From station 360+00 to 389+00, Gorge Gulch is confined in a narrow valley by steep hillslopes. The valley bottom appears to be 30 to 40 feet wide and consists of unvegetated rock debris. The channel valley slope ranges from 10 to 25 percent. Vegetation including conifers covers much of the hillslopes surrounding the valley bottom. The scale of the 1984 and 1991 photographs, and the size of the channel in this reach limit the resolution of exact channel location in this reach. The 1998 photos indicate the channel winds through the valley bottom indicating channel migration may occur. Sediment sources in this reach likely are remobilization of channel bed sediment and possibly channel migration. The high slope of this reach probably provides efficient transport of sediment supplied to this reach.

Gorge Gulch, from station 398+00 to 404+00 is confined to a valley bottom 25 to 50 feet wide by steep hillslopes. The channel has a slope 11 to 30 percent through this reach. Rock and soil deposits are located adjacent to the valley bottom from station 389+00 to 404+00 on steep hillslopes and in the steep valley bottom. These deposits are apparently from Hercules Number 4 and the Idaho and Eastern Mine. Likely sediment sources in this reach are remobilization of channel bed sediment and sediment derived from the rock debris deposits. This reach likely transports the sediment supplied very efficiently because of the steep slope.

From station 404+00 to 430+00, the end of mapped channel, conifers obscure view of the channel in the photographs. The channel is constrained to a narrow valley by steep hillslopes. Channel slope ranges from 13.5 to 30 percent. Several exposed rockpiles are scattered in the headwaters of CCSeg03. At station 411+00 a deposit from Ajax Number 2 is situated on the steep east-facing slope above Gorge Gulch. At station 141+00, a rock debris deposit is located on the west facing slopes above Gorge Gulch. Exposed rock debris from Hercules Number 2 and 3 is located on the steep hillslopes above the end of mapped channel. Several exploration drill roads cross the hillslopes surrounding Gorge Gulch in this reach. Sediment sources in this reach include remobilization of channel bed sediment, sediment derived from several rock debris deposits and sediment derived from road drainage. Highly efficient transport of sediment supplied to this reach is likely due to the steep slope of the channel.

3.2.3.4 CCSeg04 (Gem to Burke)

CCSeg04 has approximately 19,000 feet (3.6 miles) of mapped channel (Figure 3.2-18). Channel slope varies from 1 to 10 percent (Figure 3.2-13). The majority of past mining and milling activities occurred within CCSeg04. Numerous piles of rock and soil debris have been placed near or adjacent to channels or in other potentially unstable areas. The entire length of Canyon Creek in CCSeg04 is constrained to a relatively narrow valley by steep hillslopes, roads and dikes. Little lateral migration of Canyon Creek occurs in CCSeg04. Logging and other dirt roads cross the hillslopes; drainage and sediment generated from these road flow into Canyon Creek. Likely sediment sources include minor bank erosion, remobilization of channel bed sediment, rockfall, sediment from road drainage, and sediment derived of soil and rock deposits scattered throughout the segment.

From station 170+00 to 185+00, Canyon Creek is confined in a valley approximately 100 feet wide by roads and dikes. The channel slope is relatively constant varying from 1 to 3.5 percent. Little riparian vegetation is observable in the photographs reviewed. Likely sediment sources in this reach include remobilization of channel bed sediment and minor bank erosion.

Canyon Creek, from station 185+00 to 197+00, is constrained within the channel by dikes and the Gem Mill. The channel slope is approximately 2 to 3.5 percent. The channel appears to be in the same general location and channelized in the three years of photographs reviewed. Exposed soil is evident surrounding the Gem Mill site, adjacent to Canyon Creek. Sediment sources in this reach are remobilization of channel bed sediment, minor bank erosion, and sediment derived from the exposed soil surrounding the Gem Mill site.

From station 197+00 to 230+00, Canyon Creek flows through a valley approximately 200 feet wide, constrained by hillslopes and Canyon Creek Road. Channel slope through this reach ranges from 2.5 to 4 percent. The 1984 and 1991 photographs indicate a braided channel through this reach, while the 1998 photographs show that stabilization measures including rock weirs have been constructed. Lateral migration of the channel could occur if undermining or endcutting of the weirs occurs. Although somewhat obscured from view by shadows, soil and rock deposits, and rock chutes from the Frisco Mine are observable from approximate station 222+00 to 228+00 in the 1998 photographs. These deposits appear to terminate at the channel edge and along Canyon Creek Road. Little riparian vegetation is visible throughout this reach. Likely sediment sources in this reach include remobilization of channel bed sediment, minor bank erosion, and sediment derived from the Frisco Mine deposits.

The channel from station 230+00 to 253+00 is confined by two roads to a valley 150 to 200 feet wide. The channel slope ranges from 2 to 7 percent in this reach. The channel appears linear and channelized in the 1984 and 1991 photographs with mid channel bars at the downstream end of the reach, station 233+00, in 1984. Rock barbs and weirs evident in the 1998 photographs appear to have increased the sinuosity of the channel. Little riparian vegetation exists in this reach. Rock piles on the southeast side of Canyon Creek Road at station 233+00 and 243+00 appear to have increased in size from 1991 to 1999.

At station 248+00 to 253+00 a large deposit of rock debris is situated along the northwest bank of Canyon Creek apparently Tamarack Number 7. The deposit is terraced with the toe of the deposit in the Canyon Creek floodplain. Likely sediment sources in this reach include remobilization of bed sediment, minor bank erosion, and sediment derived from the rock piles at stations 233+00, 243+00, and 248+00 to 253+00. Lateral migration and additional bank erosion could occur if the rock barbs or weirs are undermined or endcut.

From Station 253+00 to 315+00, Canyon Creek flows through a valley 50 to 100 feet wide. The channel slope ranges from 2.5 to 5.5 percent. The channel alignment is constrained in position by roads, hillslopes and deposits of rock debris. Little variation in channel location is evident in the photographs reviewed. Mid-channel bars apparent in the 1984 and 1991 photographs suggest that lateral migration may occur in this reach; however, the narrow valley and numerous constraining elements provide little space for lateral migration. Little riparian vegetation is visible adjacent to the stream channel throughout this reach. A large apparent rockfall occurs from station 270+00 to 282+00 that may terminate in the channel. Deposits of sediment at the Standard-Mammoth Loading Area appear to be in contact with the channel from station 283+00 to 294+00 and from 296+00 to 300+00. Numerous waste rock deposits are evident on the steep south-facing hillside above Canyon Creek from station 280+00 to 305+00. Several exploration drill roads cross this same slope. Likely sediment sources in this reach include remobilization channel bed sediment, sediment derived from rockfall, sediment derived from the Standard-Mammoth Loading Area, sediment derived from the waste rock piles on the south-facing slop and sediment derived from road drainage.

Canyon Creek appears to be confined and channelized, possibly in a flume from station 305+(to the upstream end of CCSeg05, station 360+00. Canyon Creek flows through the Hecla-Star Mine and Mill Complex from station 338+00 to 354+00. The channel slope ranges from 3 to 10 percent in this reach. Several waste rock deposits are located on the steep south-facing slope above Canyon Creek throughout this reach. Rock debris piles from the Tiger Poorman Mine and Hercules Number 5 extend from the hillslope to the valley floor adjacent to Canyon Creek Road at stations 345+00 to 350+00 and 355+00 to 360+00, respectively. The deposits from Hercules Number 5 actually extend to 365+00 in CCSeg03. Several dirt roads cross the south-facing slope above this reach. Remobilization of channel bed sediment, sediment derived from rock debris piles on the hillslope and valley floor, and sediment derived from road drainage are the likely sediment sources in this reach.

3.2.3.5 CCSeg05 (Mouth to Gem)

CCSeg05 has approximately 17,000 linear feet (3.2 miles) of mapped channel as indicated on Figure 3.2-19. The channel slope is relatively constant ranging from 1 to 4 percent with a slightly higher slope in the upper reaches (Figure 3.2-14). Little mining or milling activities have been conducted in CCSeg05; however, tailings and other sediment from upstream mining and milling operations have been deposited in the floodplain around Woodland Park. Tailings dams 200 to 300 feet wide currently contain tailings deposits in the floodplain around and upstream of Woodland Park. Rehabilitation work, including channel stabilization measures, has been completed throughout CCSeg05. Based on aerial photograph and topographic map interpretation, the major source of sediment in CCSeg05 appears to be mobilization of channel bed sediment. Historically, channel migration has occurred throughout CCSeg05, based on review of 1984 and 1991 aerial photographs, but the recent rehabilitation efforts may reduce channel migration.

Canyon Creek, from the mouth at station 0+00 to station 25+00, is constrained in a valley 150 to 200 feet wide by Canyon Creek Road and bedrock valley walls. The channel slope ranges from about 1 to 2 percent. The Standard-Mammoth mill site is located in the floodplain from about station 6+00 to 12+00. The riparian corridor is sparsely vegetated along the channel banks. All three years of photographs indicate a similar location and alignment of the channel in this reach. Sediment sources in this reach appear to be minor bank erosion and remobilization of channel bed sediment.

Tailings deposits from the floodplain in CCSeg05 of Canyon Creek have been excavated and placed in a new repository on the south side of the valley. The stream has been reconstructed with designed habitat features to favor the return of fish if metals concentrations become sufficiently reduced. Attempts to re-vegetate the floodplain have met with limited success, grasses are the only plants surviving to any extent. Sampling of this RI suggests that some floodplain soils remain contaminated with metals. It is not known yet what the effects of tailings removal will be on loading or concentrations of metals in lower Canyon Creek. Monitoring of groundwater in the floodplain suggests that a plume of metals has formed in association with the new tailings repository.

The channel, from station 25+00 to 70+00, flows through the broad floodplain of Woodland Park. The floodplain and valley floor range from 700 to 1500 feet wide through this reach. The channel slope remains relatively constant ranging from 1.5 to 3.5 percent. The main channel through this reach appears braided at different locations in the three sets of photographs reviewed. Vegetation is sparse adjacent to the channel and in the floodplain. Channel stabilization efforts such as rock barbs, weirs, and settling pools are apparent in the 1998 photographs from station 52+00 to 70+00. A secondary drainage from the Hecla-Star Tailings Ponds and drainage area to the northwest of the Hecla-Star Tailings Ponds appears to enter the main channel of Canyon Creek and approximately station 60+00. Stabilization measures also are apparent on this secondary channel. Although stabilization measures have been completed, historical meandering and the wide valley and floodplain indicate future lateral migration may be possible. As such, the sediment sources in this reach appear to be from remobilization of channel bed sediment, lateral migration and channel bank erosion.

From station 70+00 to 90+00, Canyon Creek continues to flow through the Woodland Park Floodplain. The Hecla-Star tailings ponds occupy 200 to 300 feet of the valley width through this reach. The channel slope remains relatively constant, ranging from 2.5 to 3.5 percent. Vegetation is in the floodplain is sparse and occurs as occasional clumps of trees. From approximate station 72+00 to 78+00 a large conical pile of rock debris from the Canyon Creek Repository Reach Silver Valley Natural Resources Trustees (SVRNT) rehabilitation has been placed. This deposit appears to be isolated from Canyon Creek by a road at the base of the deposit. Review of the 1998, 1991, and 1984 aerial photographs indicates the channel has historically been braided and meandering. The 1998 photographs indicate stabilization measures such as barbs, weirs, and settling ponds have been completed in this reach. The stabilization measures may control lateral migration; however, undercutting or endcutting is possible with these types of structures. Historical meandering in a broad floodplain indicate likely sediment sources in this reach are remobilization of channel bed sediment, lateral migration and channel bank erosion.

Upstream of the Ponderosa Way road crossing at station 90+00, to station 120+00, the effective valley width decreases to approximately 150 feet by valley walls to the southeast and the Hecla-Star Tailings Ponds to the northwest. The channel slope through this reach remains relatively constant at 1.5 to 3 percent. Vegetation in the floodplain is not apparent in the photographs reviewed. The channel appears to have a braided meandering form in the 1984 photographs; 1991 photographs were not available for review. Remedial stabilization measures including rock barbs and weirs are apparent in the 1998 photographs. The relatively narrow valley width and remedial measures provide decreased likelihood of lateral migration through this reach as compared to downstream reaches; however, there is historical evidence of migration and future migration is possible. Likely sediment sources in this reach are remobilization of channel bed sediment and minor bank erosion.

From station 120+00, the approximate upstream extent of the Hecla-Star Tailings Ponds, to station 155+00 the floodplain widens to about 500 feet. Channel slope through this reach varies from 2 to 7 percent. Vegetation in the floodplain is sparse occurring as small clumps of trees. A deposit from the Canyon Creek Formosa Reach SVRNT rehabilitation is shown in the 1998 photographs at approximate station 126+00 on the hillslope above the valley floor. This deposit appears to be isolated from the channel by a road at the base of the deposit. The 1984 photographs indicate a straight channel alignment through this reach, indicating this reach may have been channelized. Several mid-channel bars are discernable in the 1984 photographs. Stabilization measures such as rock barbs or weirs are shown in the 1998 photographs. Mid-channel bars are also shown in the 1998 photographs. The mid-channel bars and wide floodplain indicate lateral migration of the channel is possible in this reach. The stabilization measures may control the lateral migration; however, undercutting or endcutting is possible with these types of structures. As such, likely sediment sources in this reach are remobilization of channel bed sediment, lateral migration and channel bank erosion.

Canyon Creek from station 155+00 to 170+00, the upstream end of CCSeg05, is constrained in a valley 100 to 200 feet wide by hillslopes, roads and possibly a dike. The channel slope varies from 2 to 10 percent. Little riparian vegetation is observable. The channel appears to be in the same general location in each of the photographs reviewed. Likely sediment sources in this reach include minor bank erosion and remobilization of channel bed sediment.

3.3 SUMMARY

Based on the information discussed above, approximately 1,400 tons, or 62 tons per square mile, of sediment was transported from Canyon Creek to the South Fork Coeur d'Alene River in water year 1999. Sediment sources occur in all five segments. Based on interpretation of aerial photograph from 1984, 1991, and 1998, the majority of the sediment supplied to the creek appears to originate in CCSeg05, CCSeg04, and CCSeg03. Large rock and soil deposits are positioned adjacent to the stream channel and on hillslopes, which drain to the steam in CCSeg03 and CCSeg04. Lateral migration of the channel has been observed in the historical aerial photographs in CCSeg04 and CCSeg05. Channelization, bed controls, deposition pools, and isolating rock and soil deposits away from the channel have previously been used in these segments to reduce the sediment yield of the basin. These efforts have likely reduced the sediment load over time. The sediment yield has also presumably been reduced through time since discharging mine-related debris directly into the channel has ceased.

Throughout the basin, high densities of logging and other dirt roads exist. Drainage from roads concentrates water and sediment discharge particularly sand and silt. More detailed study of the road drainage and sediment discharge from these roads may be needed in conjunction with future remedial action.

Additional areas where stabilization measures could be taken include areas where local scour, minor bank erosion, and mobilization of channel bed material occur. These areas are located throughout the watershed.

These observations were based on a limited review of the available data, photographs, and topographic maps at the time of review. Not all potential sediment sources were identified, as potential sediment sources literally cover the entire watershed. Primary sources were identified based on review of the available information.

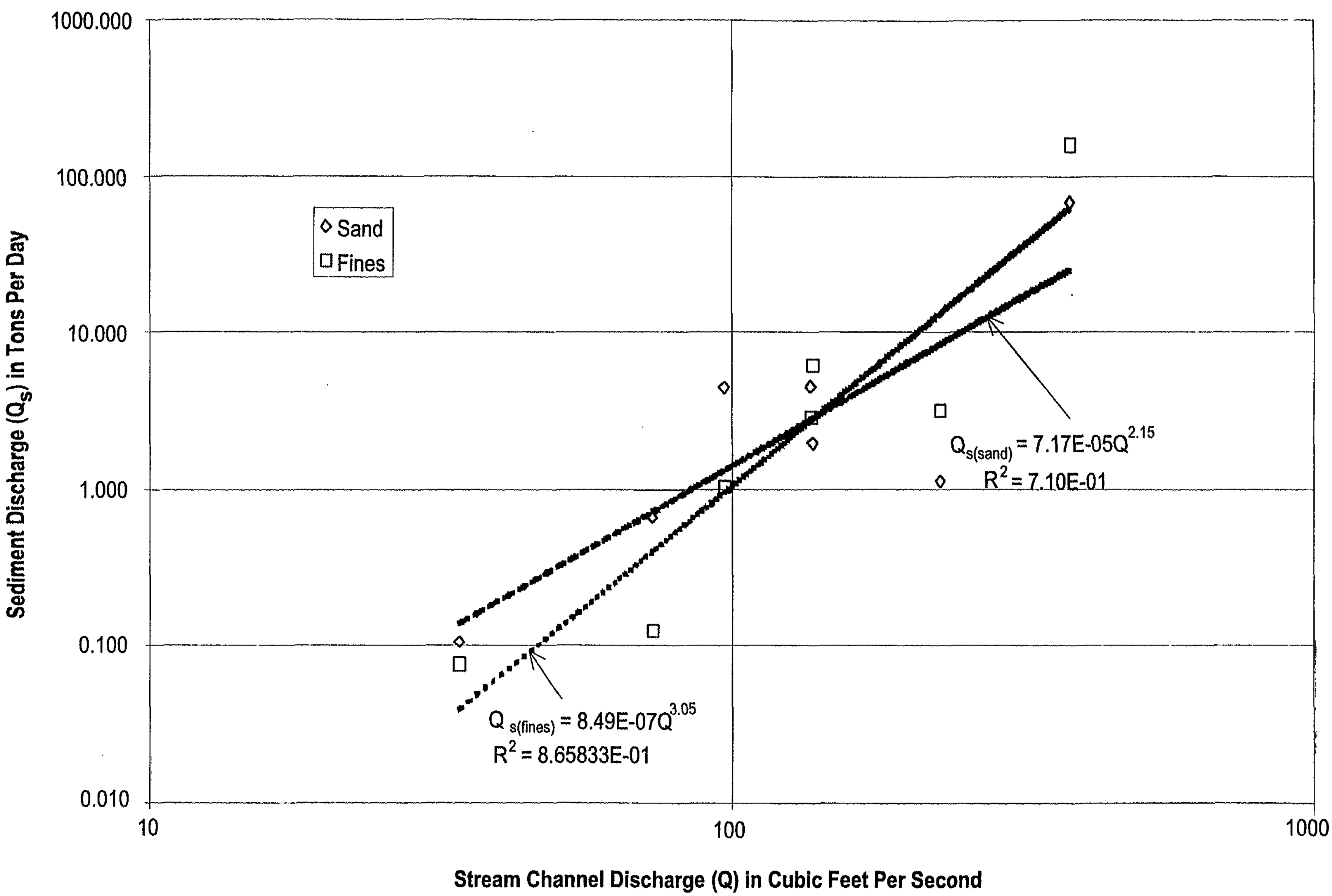


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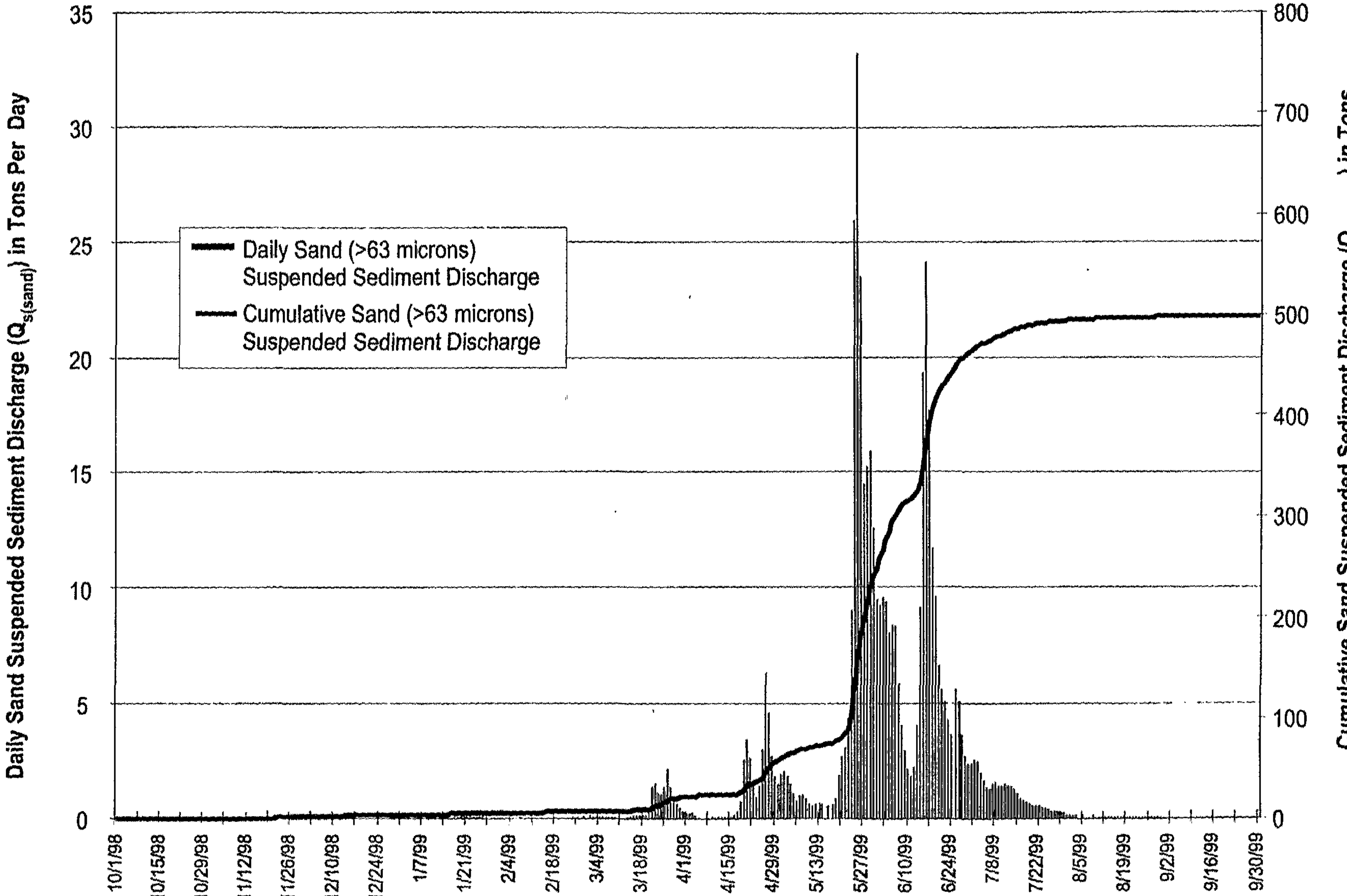
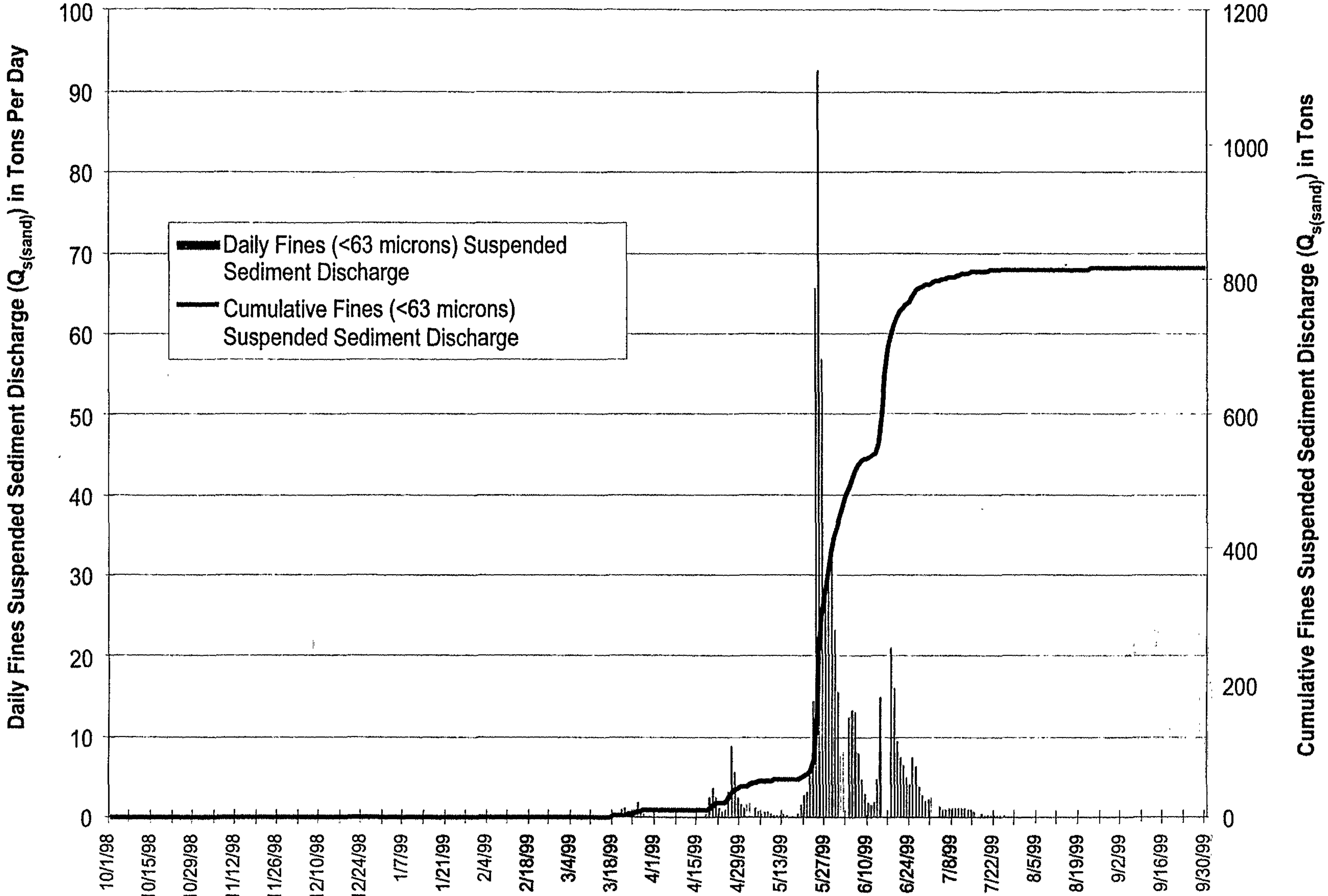
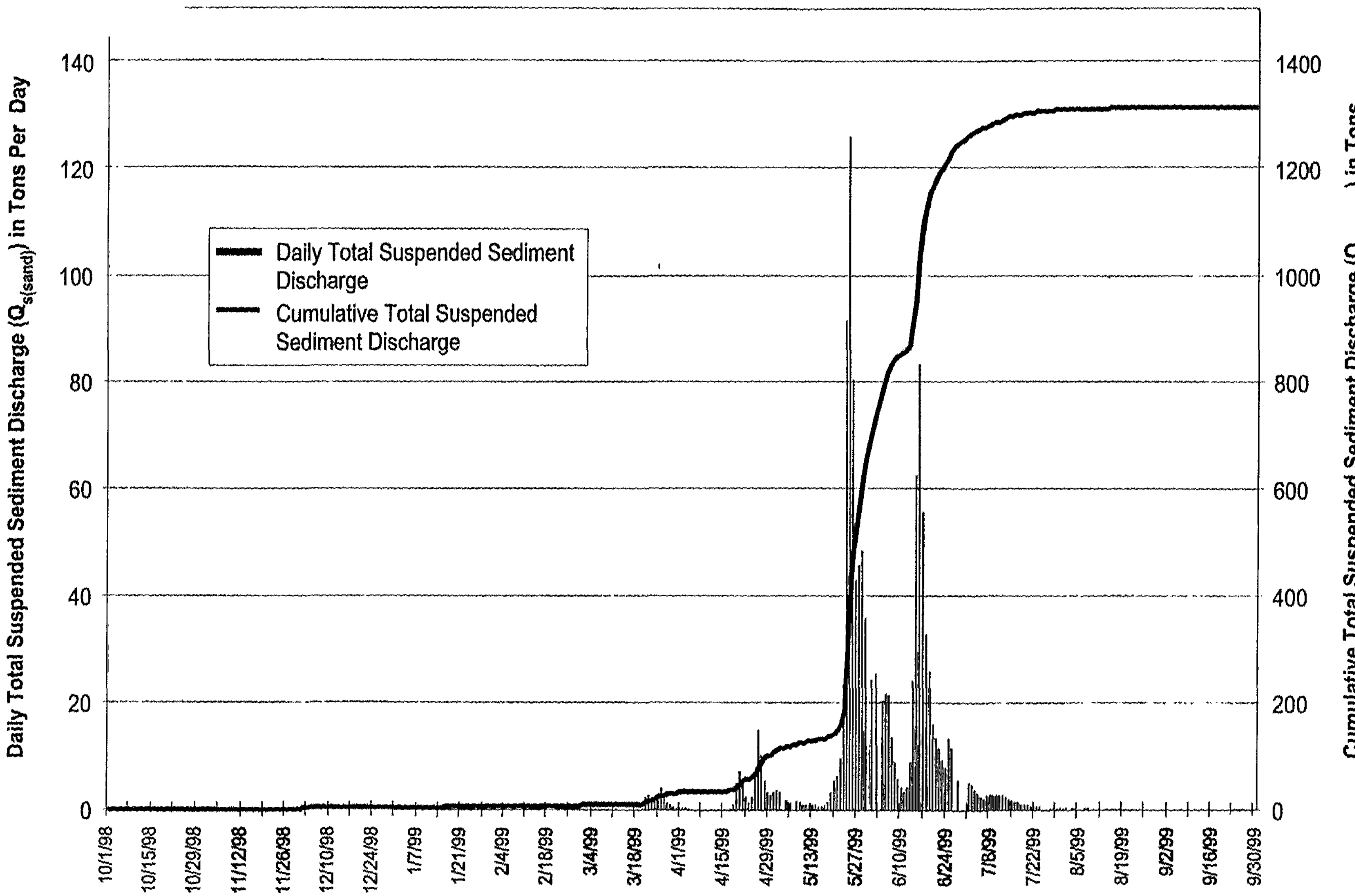
Figure 3.2-1
Suspended Sediment Rating Curves, Canyon Creek at Wallace, Station 12413125
Suspended Sediment by Sand Break, Water Year 1999



EPA REGION	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc. Control: 4162500.6615.05.a Generation: 1 CC-37 071200	**Figure 3.2-2** **Sand Suspended Sediment Discharge, Canyon Creek at Wallace, Station 12413125** **Daily and Cumulative Totals, Water Year 1999**



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc. Control: 4162500.6615.05.a Generation: 1 CC-38 071200	**Figure 3.2-3** **Fines Suspended Sediment Discharge, Canyon Creek at Wallace, Station 12413125** **Daily and Cumulative Totals, Water Year 1999**



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RI REPORT

Doc. Control: 4162500 6615 05.a
Generation: 1

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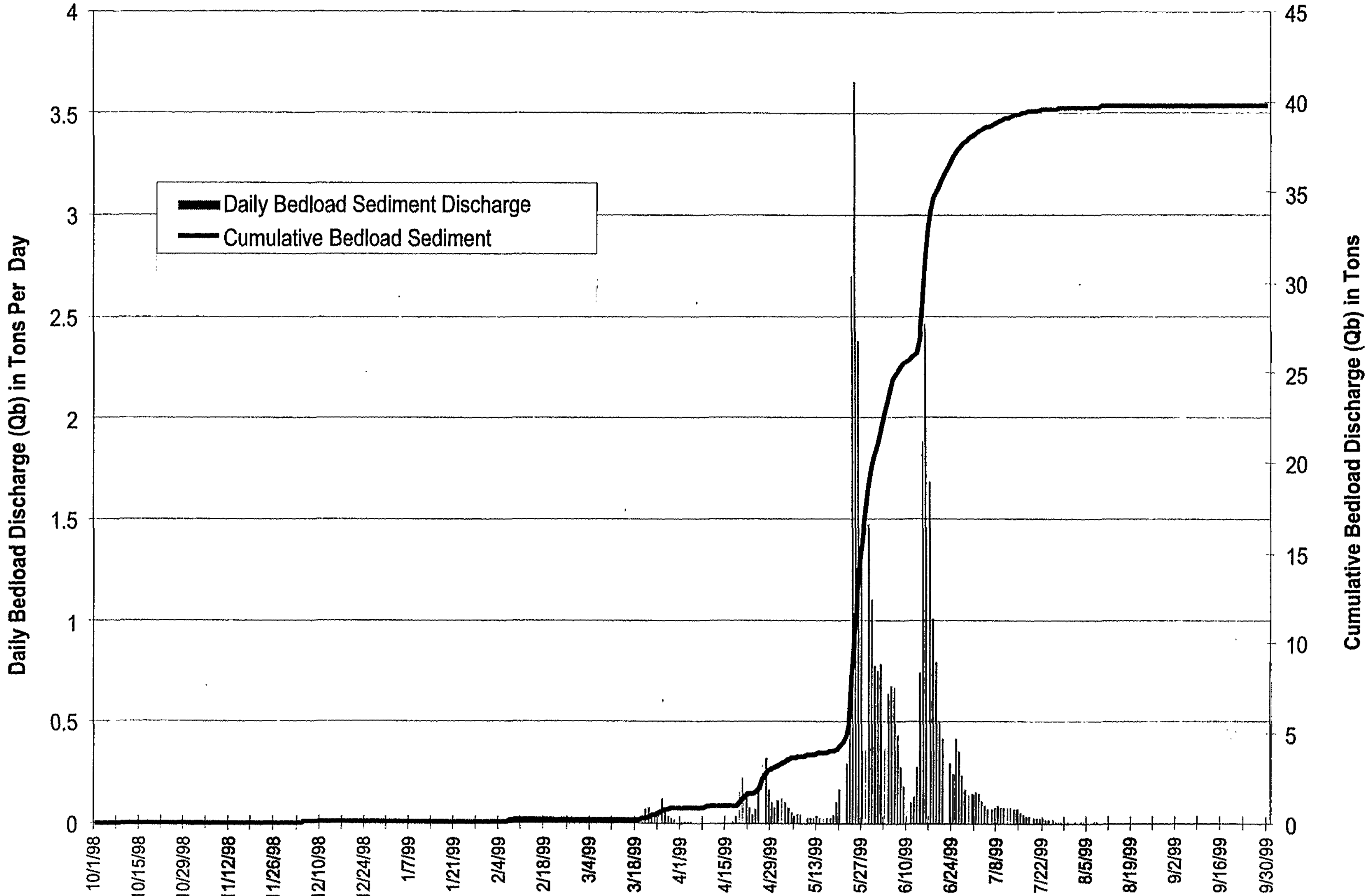
071200

Figure 3.2-4
Total Suspended Sediment Discharge, Canyon Creek at Wallace, Station 12413125
Daily and Cumulative Totals, Wate ar 1999



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Generation: 1

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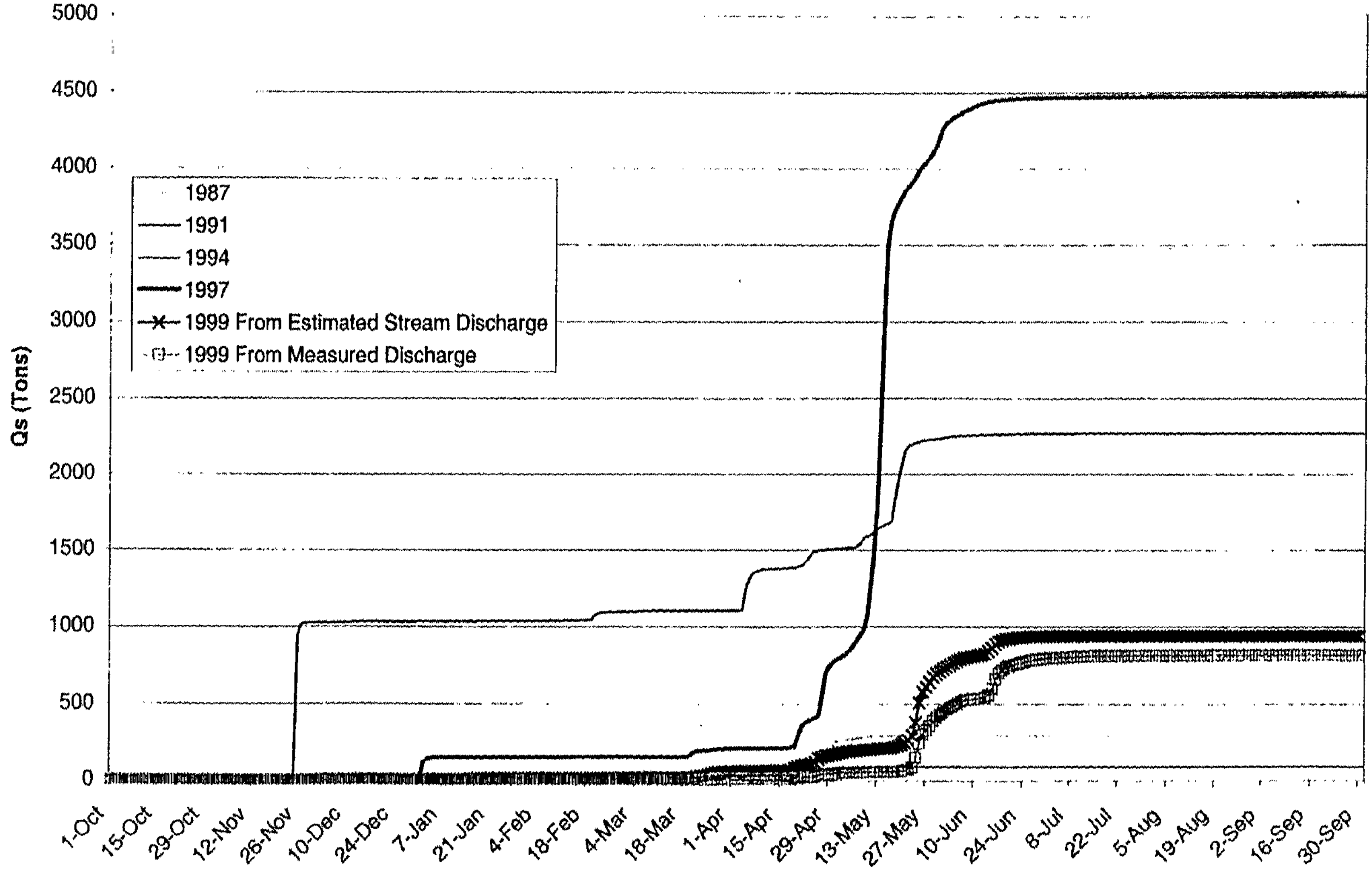
Figure 3.2-5
Bedload Sediment Discharge, Canyon Creek at Wallace, Station 12413125



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Generation: 1

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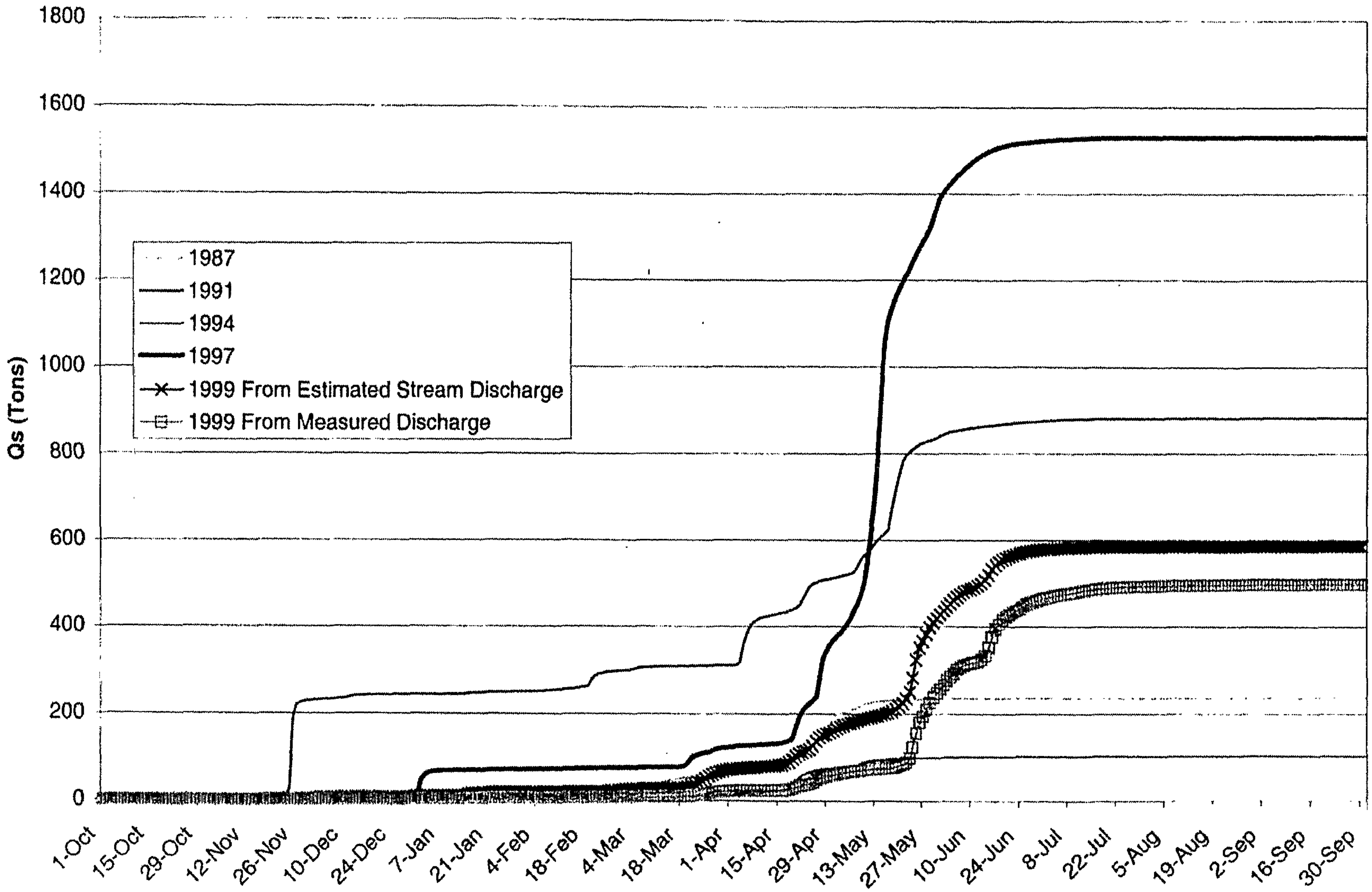
Figure 3.2-6
Estimated Cumulative Fines Sedimen[illegible]sport



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc. Control: 4162500.6615.05.a Generation: 1 CC-41 071200	**Figure 3.2-7** **Estimated Cumulative Sand Sediment Transport**

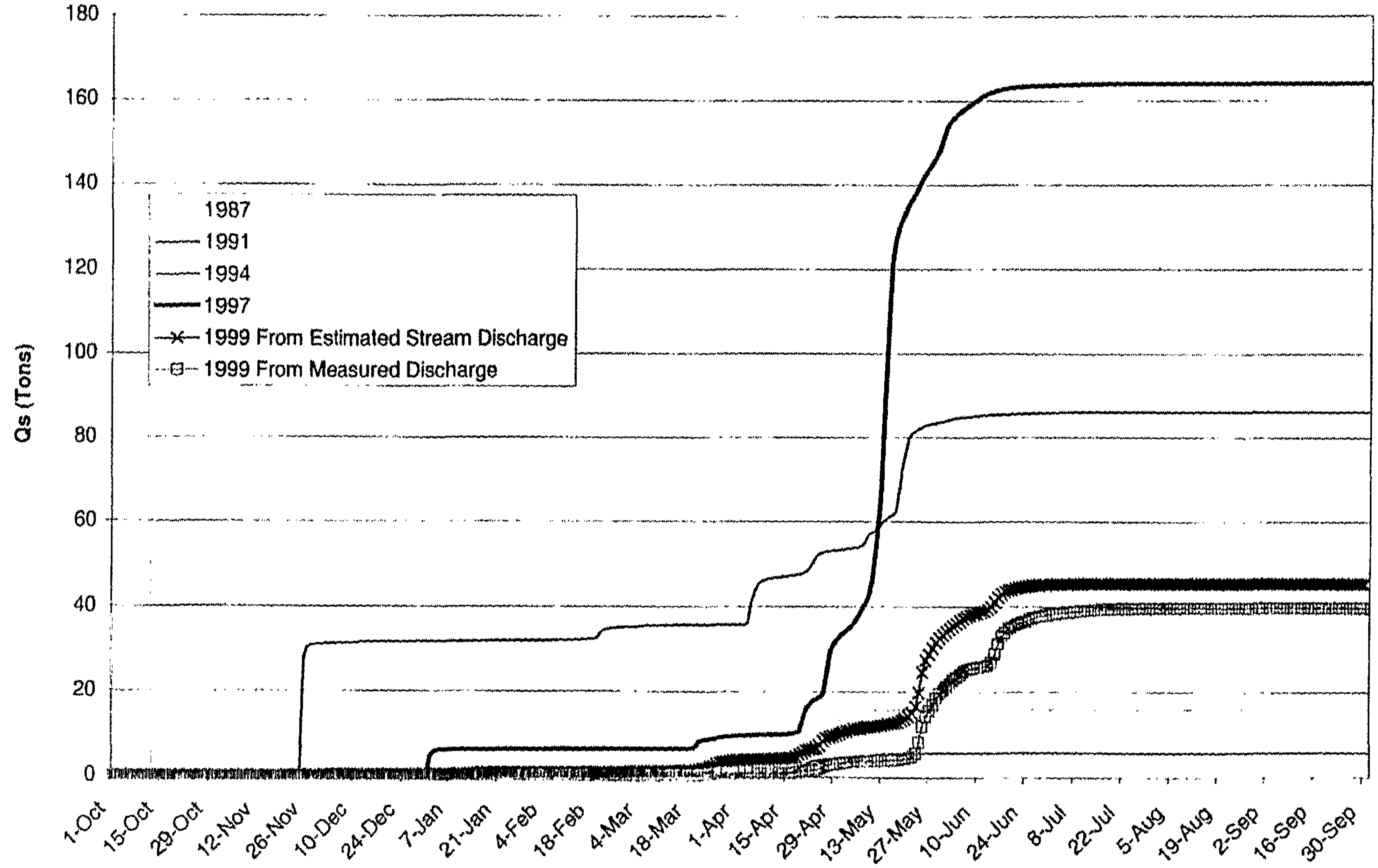
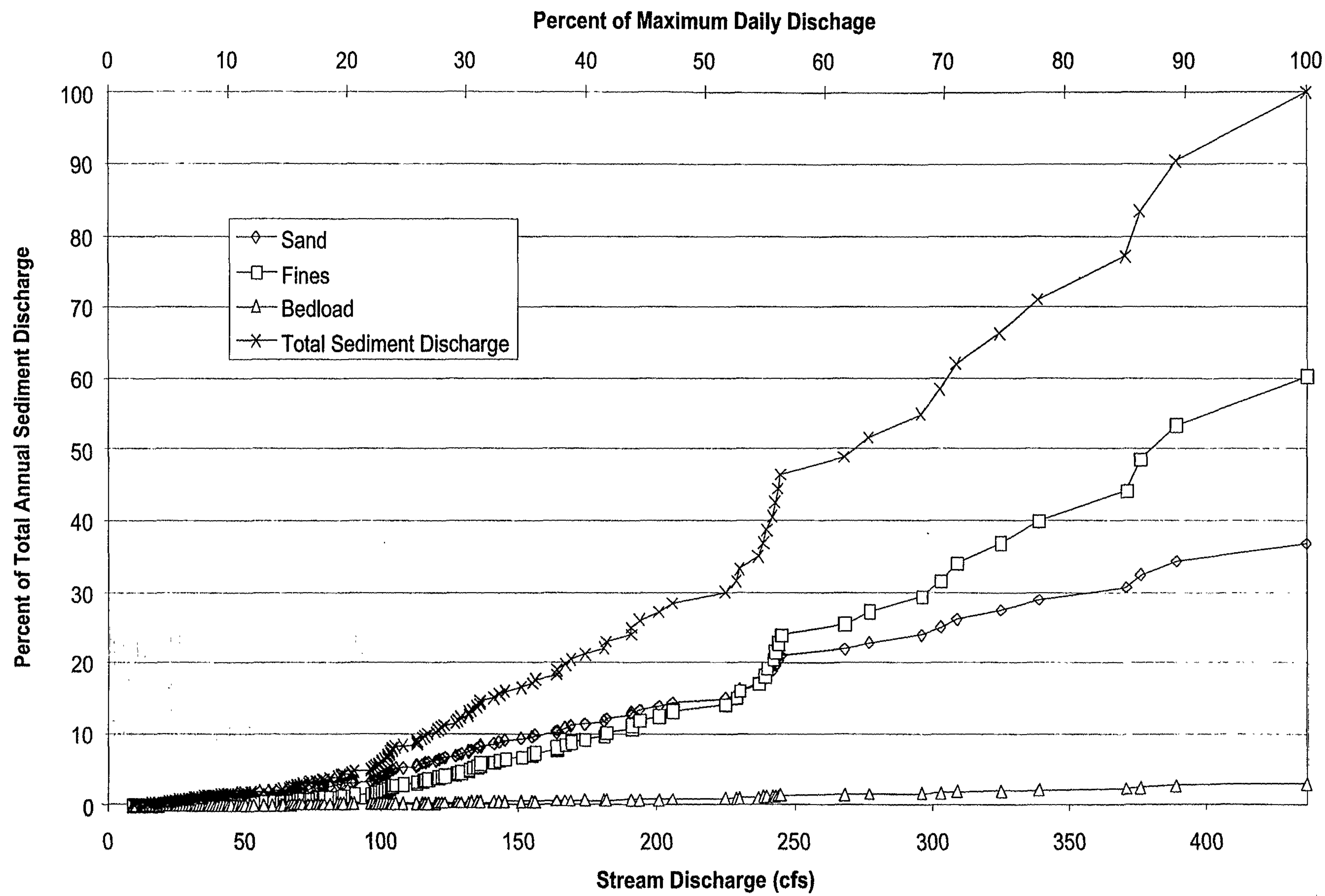
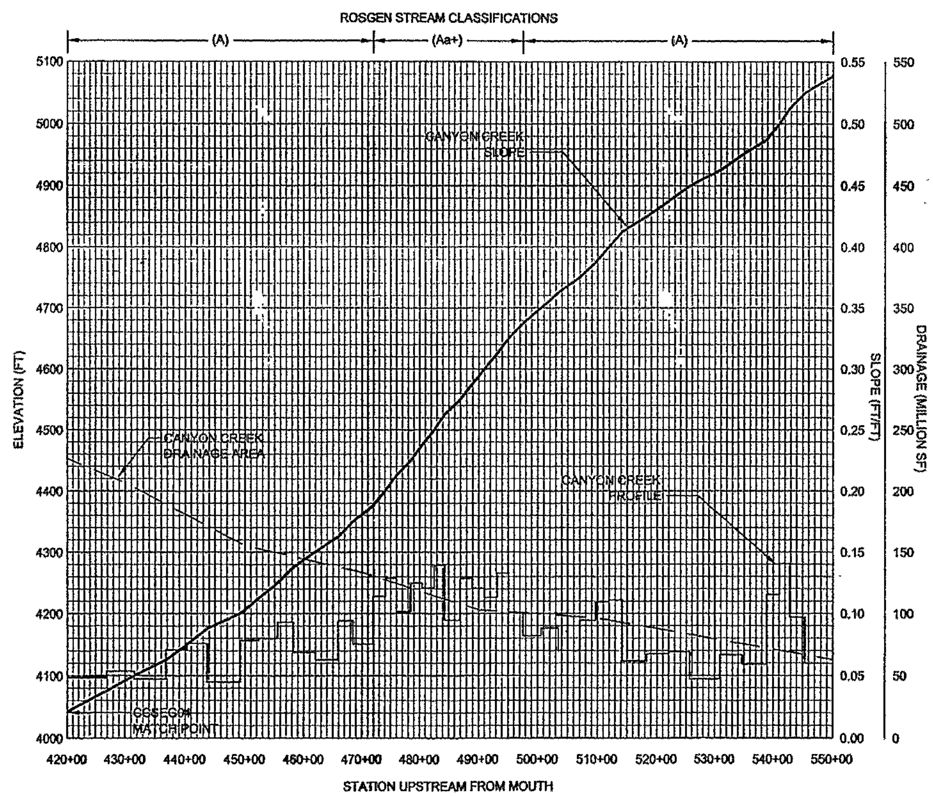


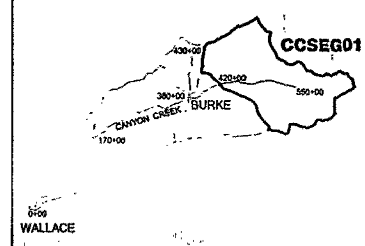
Figure 3.2-8
Estimated Cumulative Bedload Sediment Transport



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc. Control:4162500.6615.05.a Generation: 1 CC-43 071200	Figure 3.2-9 Canyon Creek, Percent of Total Annual Sediment Discharge Versus Stream Discharge Water Year 1999

Figure 3.2-10
Canyon Creek Segment 01
Rosgen Stream Classification





LEGEND

- SEGMENT PROFILE
- SEGMENT SLOPE
- SEGMENT DRAINAGE AREA (SF)

NOTES:

1. CHANNEL PROFILE AND SLOPES ARE APPROXIMATE AND BASED ON MAP PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. DRAINAGE AREAS ARE APPROXIMATE AND MAY NOT BE LINEAR AS INDICATED BY PLOT.

54-50-0C2Q
Coeur d'Alene Basin RI/FS
RI Report

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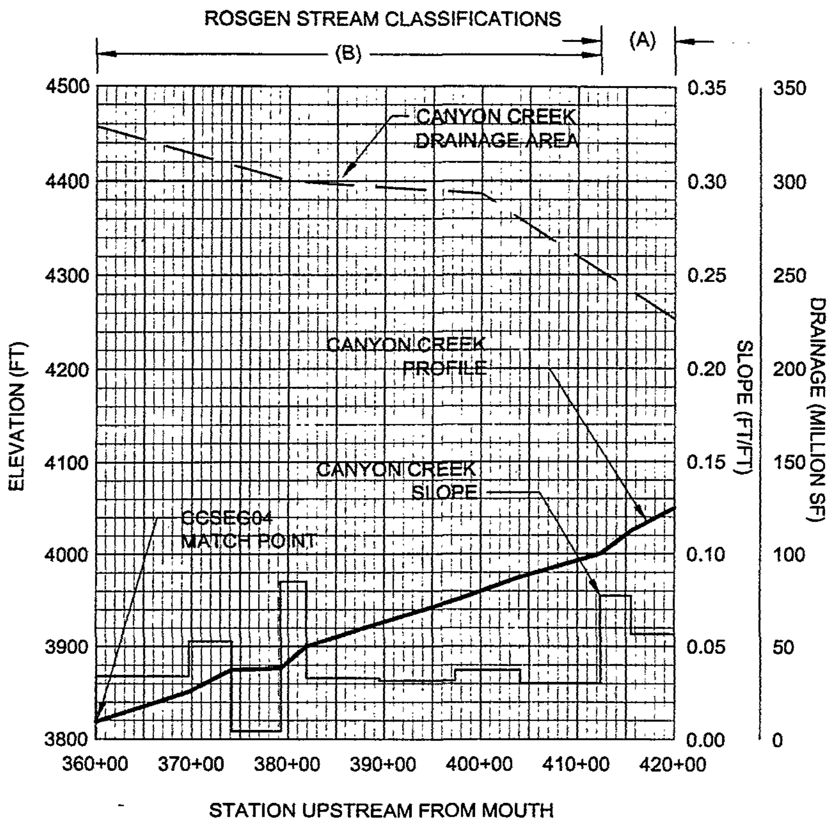
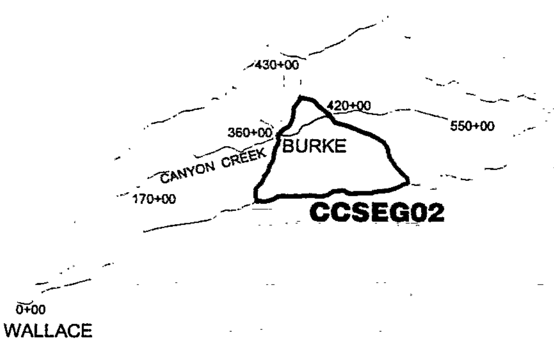
07/30/2001





LEGEND

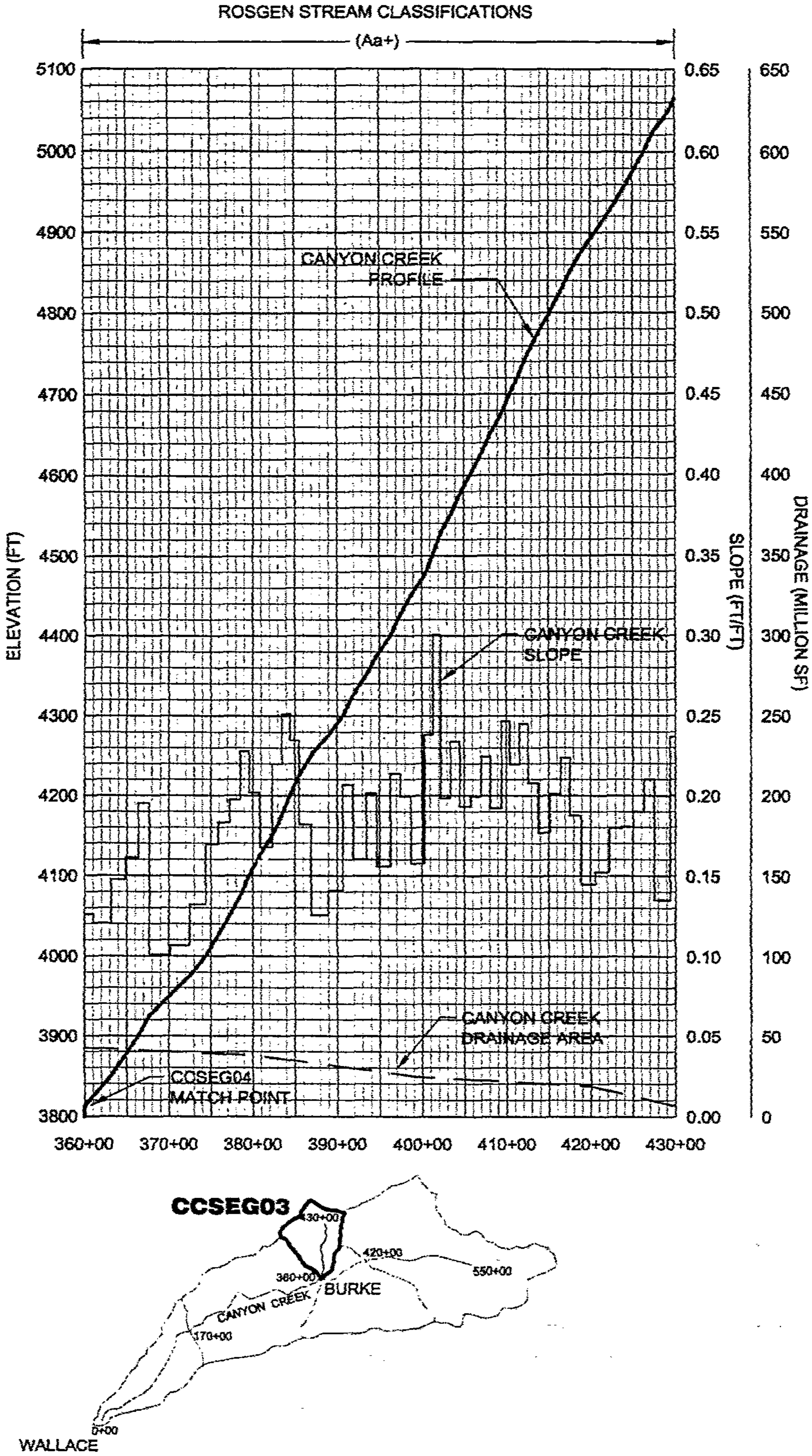
- SEGMENT PROFILE
- SEGMENT SLOPE
- SEGMENT DRAINAGE AREA (SF)

NOTES:

1. CHANNEL PROFILE AND SLOPES ARE APPROXIMATE AND BASED ON MAP PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. DRAINAGE AREAS ARE APPROXIMATE AND MAY NOT BE LINEAR AS INDICATED BY PLOT.

0 2000 4000
Scale in Feet

EPA REGION 10	54-50-0C2Q Coeur d'Alene Basin RI/FS RI Report	Doc. Control: 4162500.6615.05.a Generation: 2 I:Groups/Public/Cda/Drawings/ Canyon_Section-RI.dwg Layout: CCSeg02 07/31/01	**Figure 3.2-11** **Canyon Creek Segment 02 Section** **Rosgen Stream Classification**



LEGEND

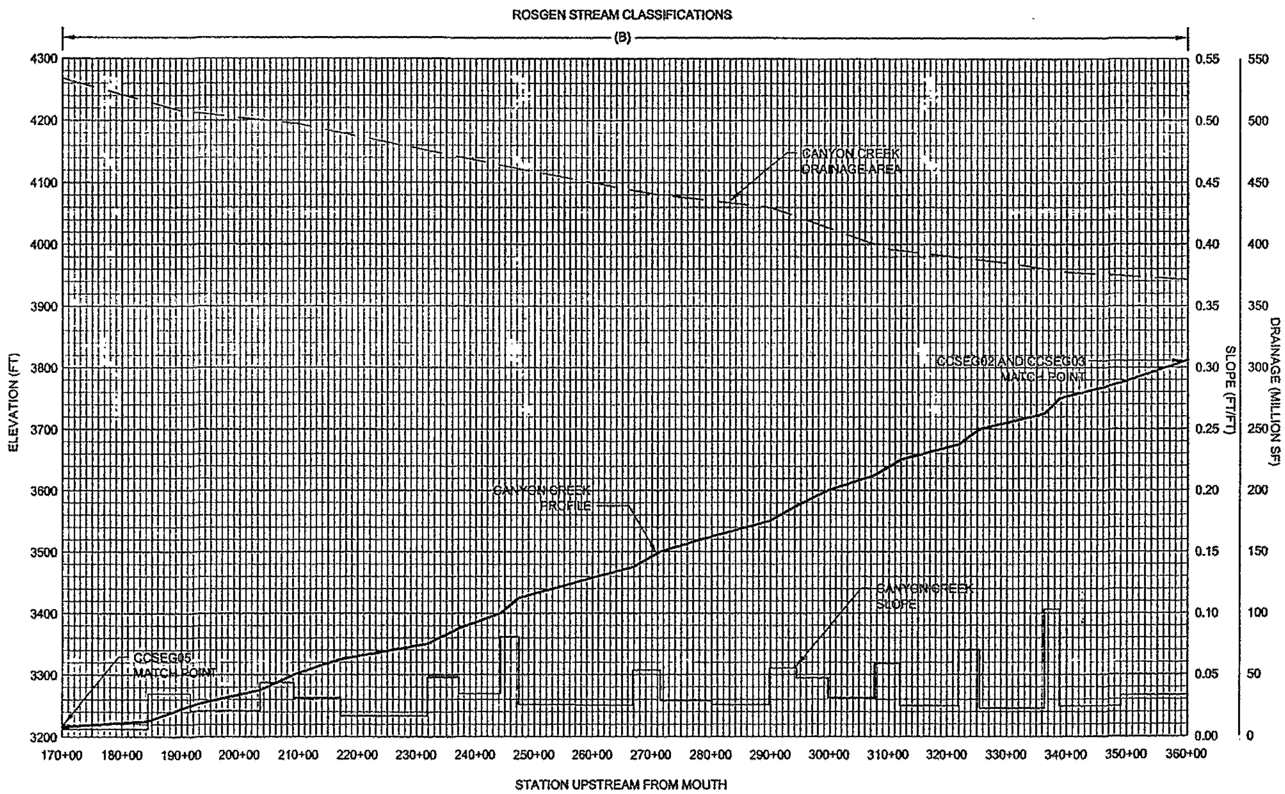
- SEGMENT PROFILE
- SEGMENT SLOPE
- SEGMENT DRAINAGE AREA (SF)

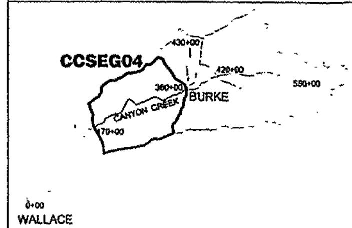
NOTES:

1. CHANNEL PROFILE AND SLOPES ARE APPROXIMATE AND BASED ON MAP PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. DRAINAGE AREAS ARE APPROXIMATE AND MAY NOT BE LINEAR AS INDICATED BY PLOT.

Figure 3.2-12
Canyon Creek Segment 03
Rosgen Stream Classifications

Figure 3.2-13
Canyon Creek Segment 04
Rosgen Stream Classification





LEGEND
- SEGMENT PROFILE
- SEGMENT SLOPE
- SEGMENT DRAINAGE AREA (SF)

NOTES:
1. CHANNEL PROFILE AND SLOPES ARE APPROXIMATE AND BASED ON MAP PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. DRAINAGE AREAS ARE APPROXIMATE AND MAY NOT BE LINEAR AS INDICATED BY PLOT.

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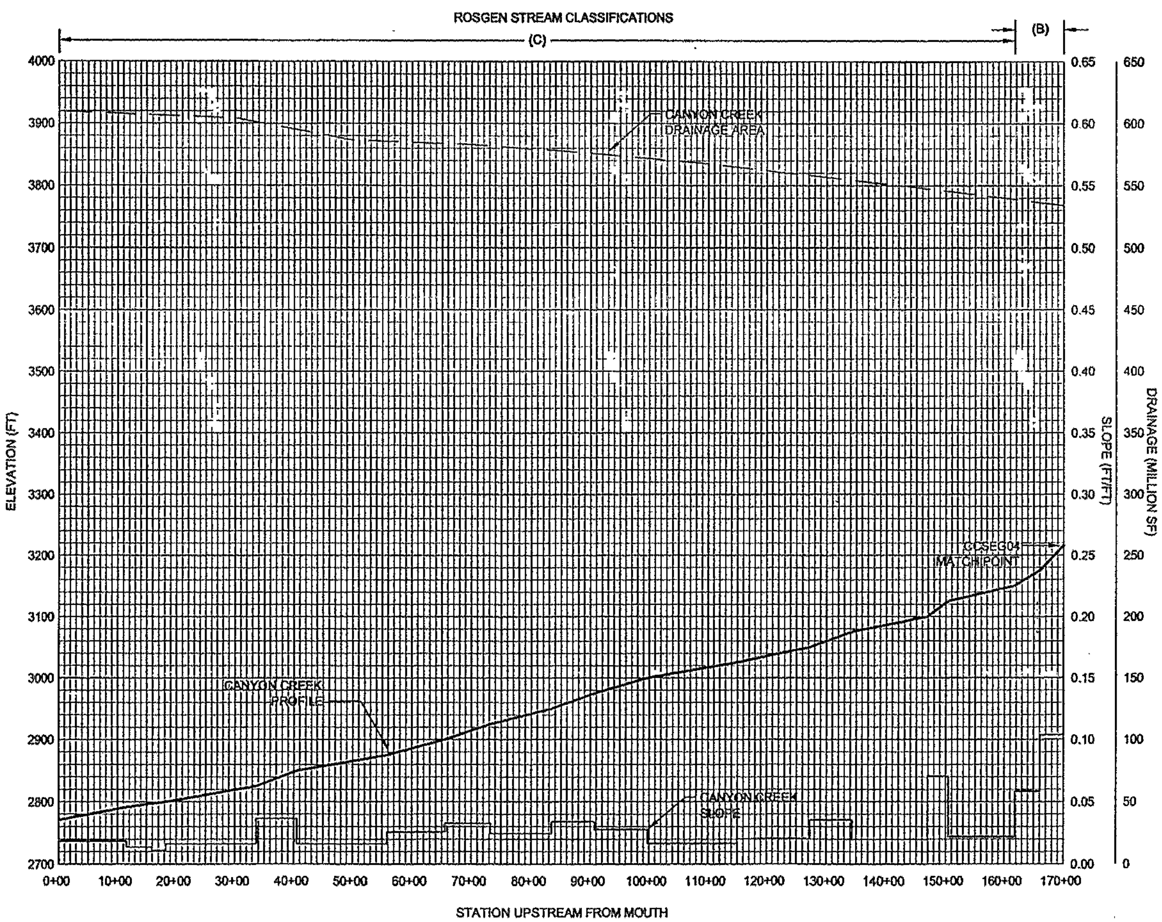
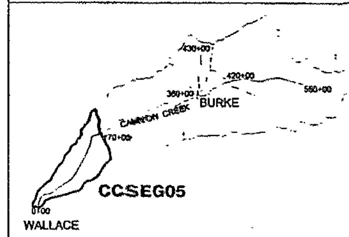
Generation: 2
Layout: CCSeg04
07/30/2001

Figure 3.2-14
Canyon Creek Segment 05
Rosgen Stream Classifications





LEGEND

- SEGMENT PROFILE
- SEGMENT SLOPE
- SEGMENT DRAINAGE AREA (SF)

NOTES:

1. CHANNEL PROFILE AND SLOPES ARE APPROXIMATE AND BASED ON MAP PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. DRAINAGE AREAS ARE APPROXIMATE AND MAY NOT BE LINEAR AS INDICATED BY PLOT.

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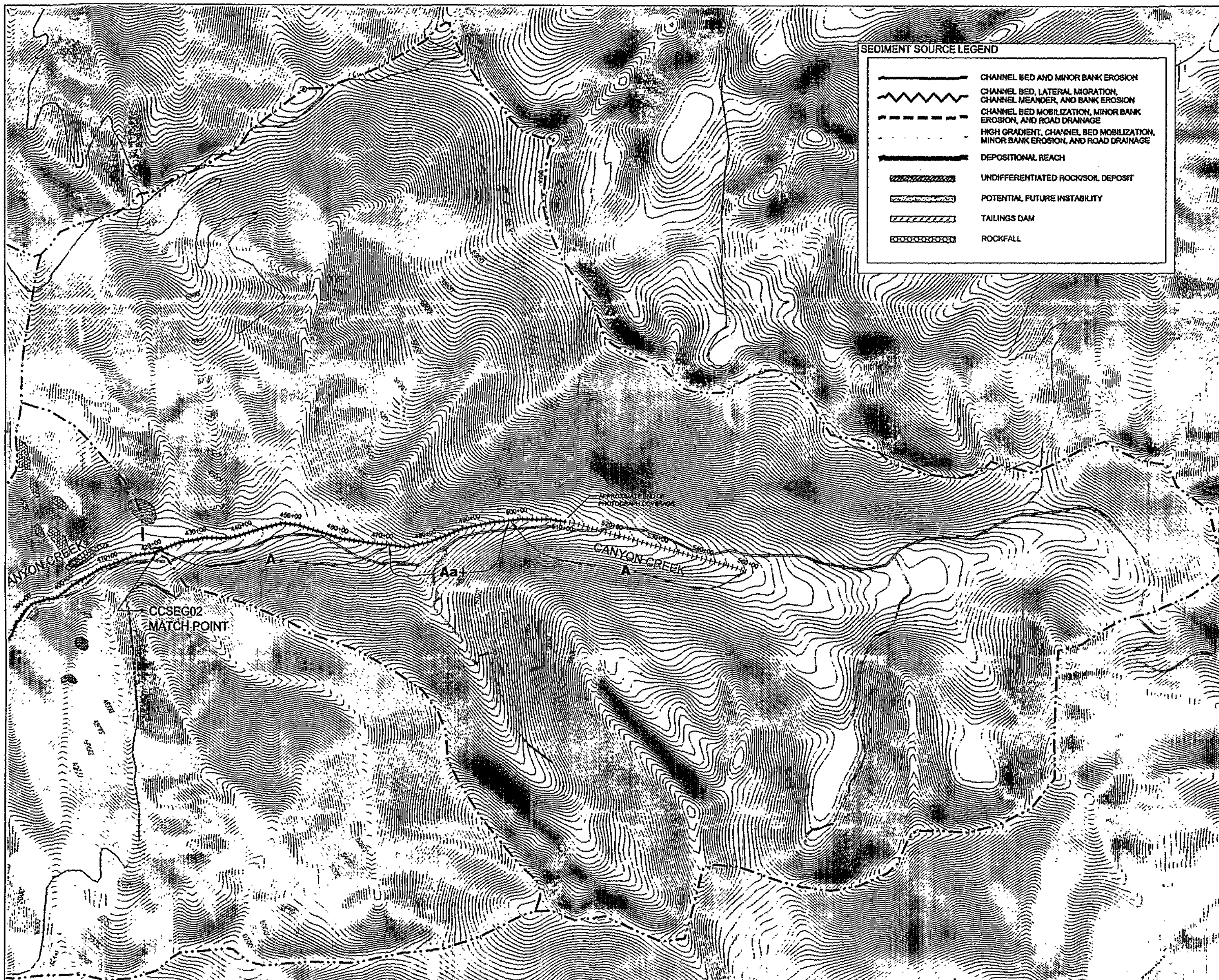
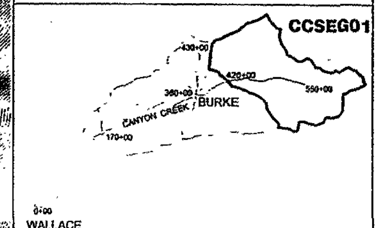
Coeur d'Alene Basin RI/FS
RI Report

EPA
REGION 10

Doc Control: 4162500 6815 RS ai
Generation: 2
Layout: CCSeg05
07/30/2001

Figure 3.2-15
Canyon Creek Segment 01 Site Plan





LEGEND

- BASIN BOUNDARY
- CONTOUR LINE
- CHANNEL CENTERLINE
- INTERSTATE/ROAD/TRAIL
- Aa+ ROSGEN CLASSIFICATION

NOTES:

1. MAP FEATURES AND CONTOURS PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. CONTOUR INTERVAL IS 25 FEET.
4. CHANNEL CENTERLINE TAKEN AT APPROXIMATE LOW POINT OF STREAM CHANNEL.
5. SEDIMENT SOURCE LOCATIONS ARE APPROXIMATE AND ARE BASED ON TOPOGRAPHIC MAP AND AERIAL PHOTOGRAPH INTERPRETATION.

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Coeur d'Alene Basin RI/FS
RI REPORT

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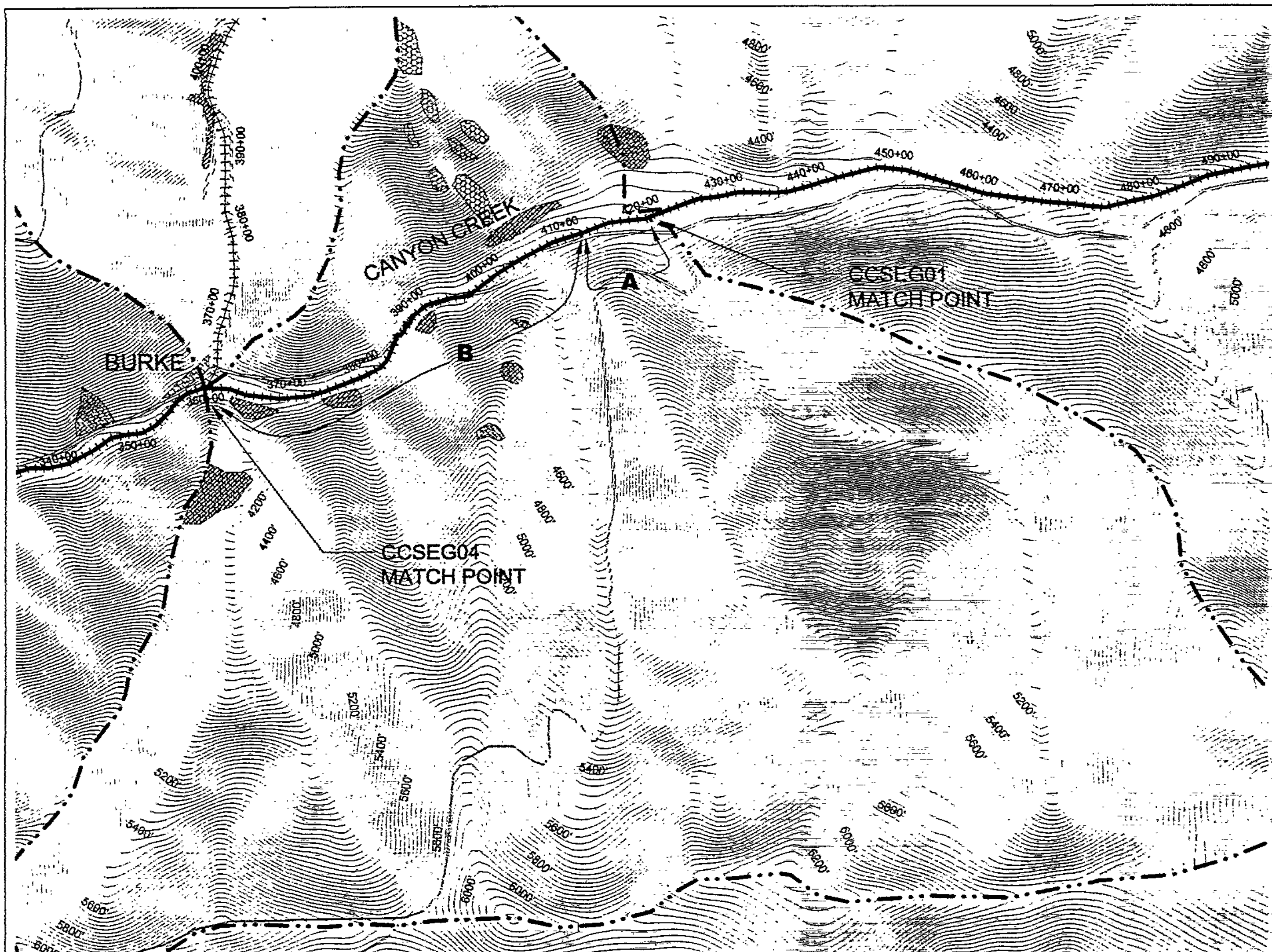
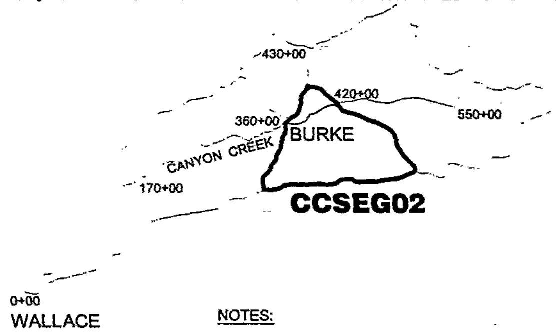
Layout: CCSeg01
07/30/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 30 2001





SEDIMENT SOURCE LEGEND

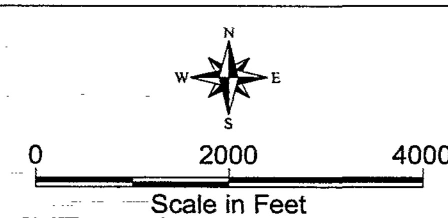
- CHANNEL BED AND MINOR BANK EROSION
- CHANNEL BED, LATERAL MIGRATION, CHANNEL MEANDER, AND BANK EROSION
- CHANNEL BED MOBILIZATION, MINOR BANK EROSION, AND ROAD DRAINAGE
- HIGH GRADIENT, CHANNEL BED MOBILIZATION, MINOR BANK EROSION, AND ROAD DRAINAGE
- DEPOSITIONAL REACH
- UNDIFFERENTIATED ROCK/SOIL DEPOSIT
- POTENTIAL FUTURE INSTABILITY
- TAILINGS DAM
- ROCKFALL

NOTES:

1. MAP FEATURES AND CONTOURS PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. CONTOUR INTERVAL IS 25 FEET.
4. CHANNEL CENTERLINE TAKEN AT APPROXIMATE LOW POINT OF STREAM CHANNEL.
5. SEDIMENT SOURCE LOCATIONS ARE APPROXIMATE AND ARE BASED ON TOPOGRAPHIC MAP AND AERIAL PHOTOGRAPH INTERPRETATION.

LEGEND

- BASIN BOUNDARY
- 4200 CONTOUR LINE
- 170+00 CHANNEL CENTERLINE
- INTERSTATE/ROAD/TRAIL
- **Aa+** ROSGEN CLASSIFICATION

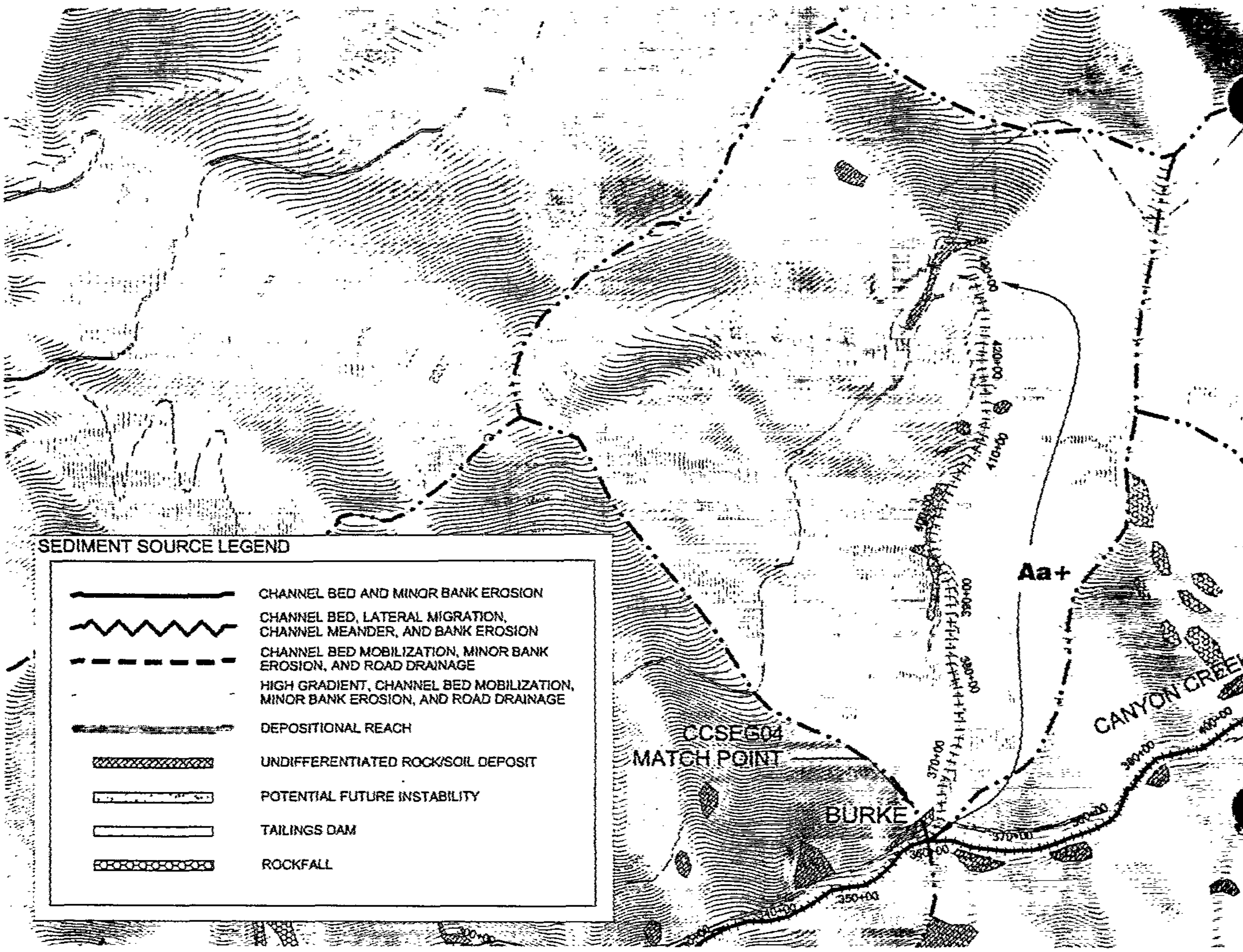


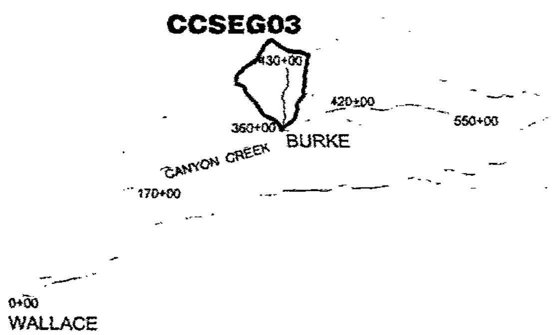
EPA REGION 10

54-50-0C2Q
Coeur d'Alene Basin RI/FS
RI Report
ASSESSMENT

Doc. Control: 4162500.6625.05.a
Generation: 2
I:Groups/Public/Cda/Drawings/
Canyon_Site2.dwg
Layout: CCSeg02
07/31/01

Figure 3.2-16
Canyon Creek Segment 02 Site Plan





NOTES:

1. MAP FEATURES AND CONTOURS PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. CONTOUR INTERVAL IS 25 FEET.
4. CHANNEL CENTERLINE TAKEN AT APPROXIMATE LOW POINT OF STREAM CHANNEL.
5. SEDIMENT SOURCE LOCATIONS ARE APPROXIMATE AND ARE BASED ON TOPOGRAPHIC MAP AND AERIAL PHOTOGRAPH INTERPRETATION.

LEGEND

- BASIN BOUNDARY
- CONTOUR LINE
- CHANNEL CENTERLINE
- INTERSTATE/ROAD/TRAIL
- **Aa+** ROSGEN CLASSIFICATION

N / W / E / S

0 2000 4000
Scale in Feet

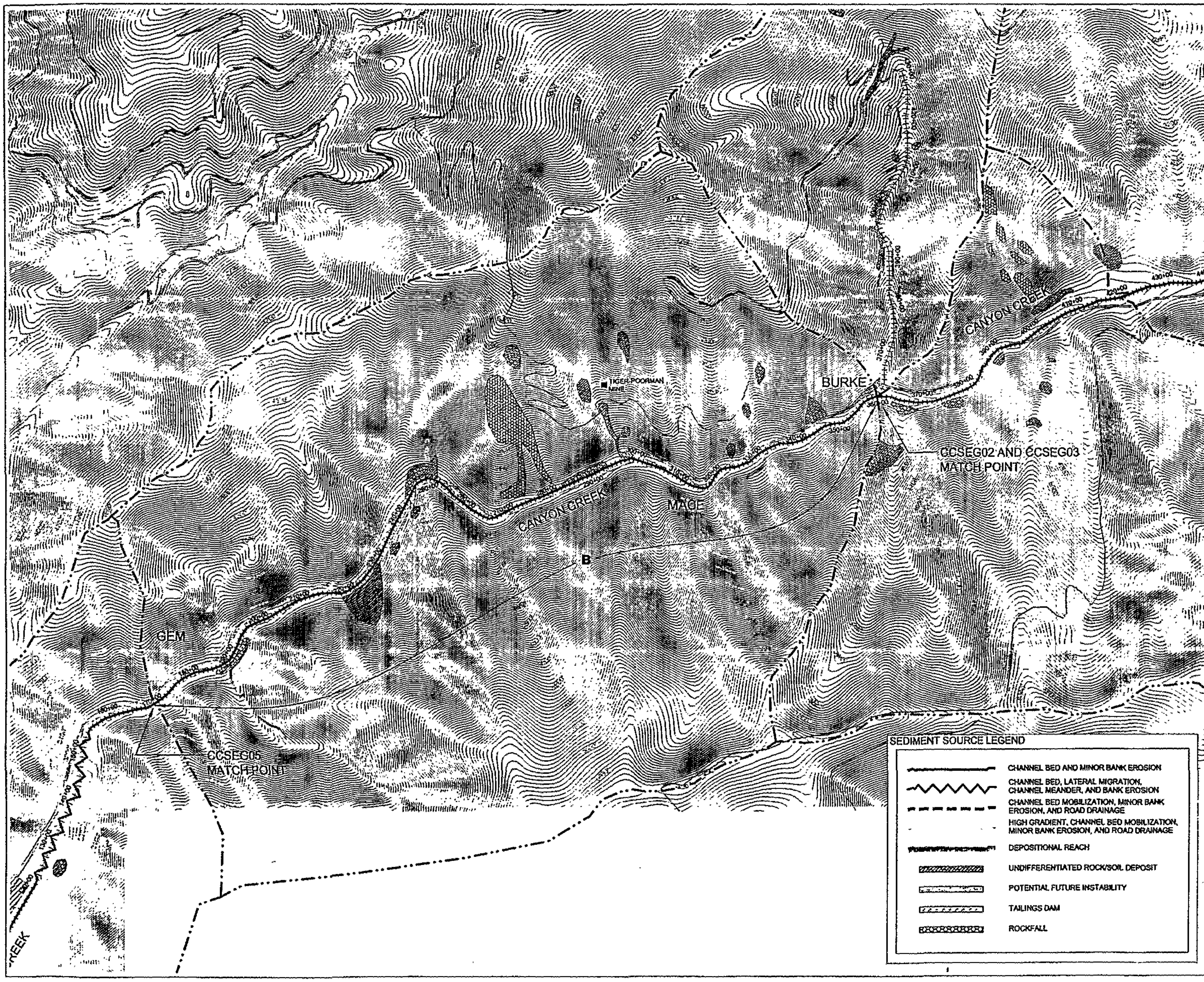
EPA REGION 10

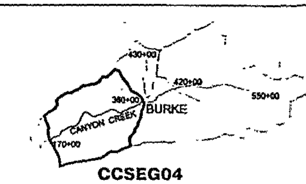
027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

Doc. Control: 4162500.6615.05a
Generation: 2
I:Groups/Public/Cda/Drawings/Canyon_Site.dwg
Layout: CCSeg03
07/31/01

Figure 3.2-17
Canyon Creek Segment 03 Site Plan

Figure 3.2-18
Canyon Creek Segment 04 Site Plan





LEGEND

- BASIN BOUNDARY
- CONTOUR LINE
- CHANNEL CENTERLINE
- INTERSTATE/ROAD/TRAIL
- Aa+ ROSGEN CLASSIFICATION

NOTES:

1. MAP FEATURES AND CONTOURS PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS. REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. CONTOUR INTERVAL IS 25 FEET.
4. CHANNEL CENTERLINE TAKEN AT APPROXIMATE LOW POINT OF STREAM CHANNEL.
5. SEDIMENT SOURCE LOCATIONS ARE APPROXIMATE AND ARE BASED ON TOPOGRAPHIC MAP AND AERIAL PHOTOGRAPH INTERPRETATION.

N W E S

0 2000 4000
Scale in Feet

54-50-0C2Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Doc. Control: 4162500.6615.05.a
Generation: 2
I:Groups/Public/Cda/Drawings/
Canyon_Site dwg
Layout: CCSeg04
07/30/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: April 21, 2000

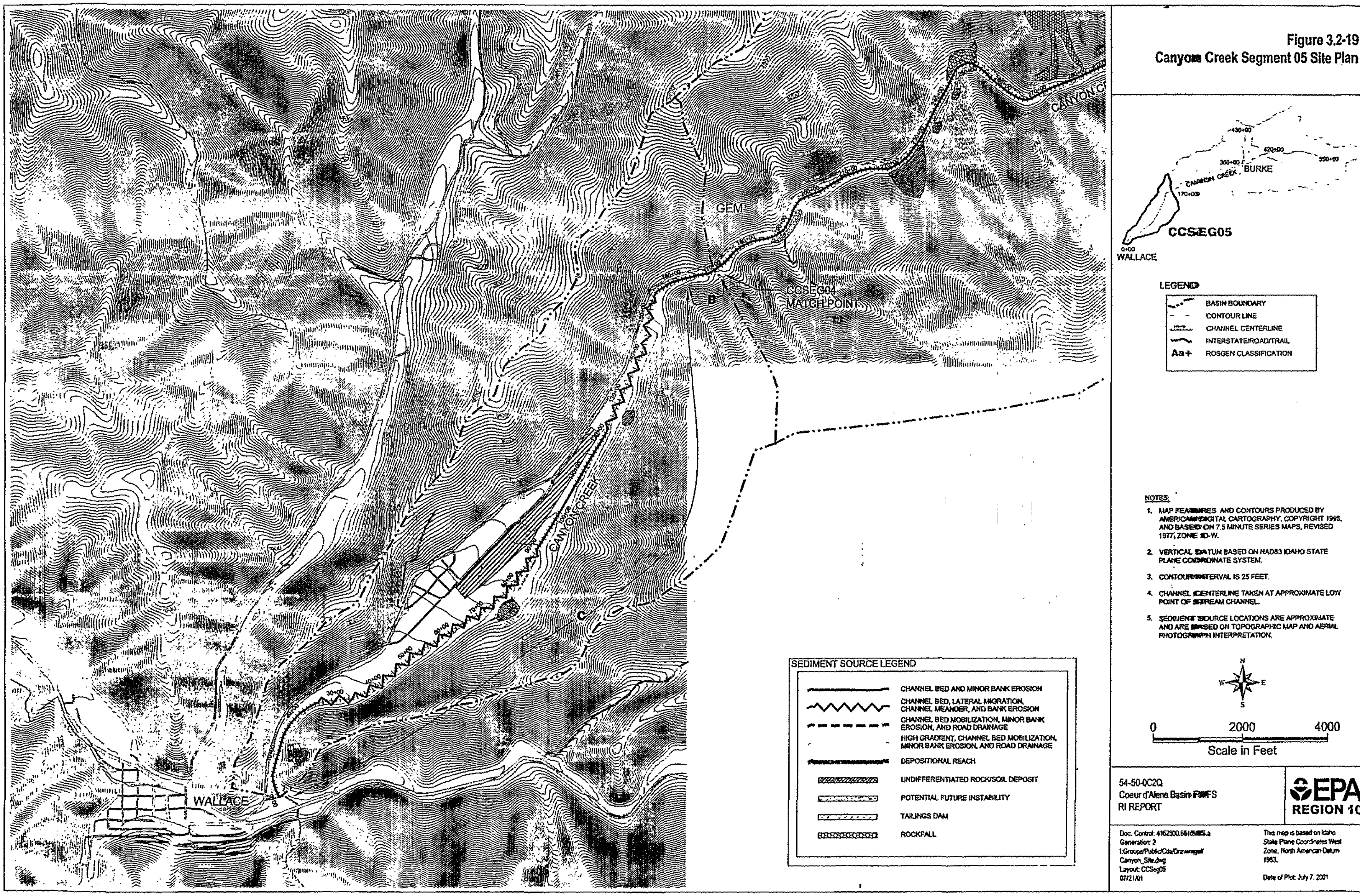


Figure 3.2-19
Canyon Creek Segment 05 Site Plan

Table 3.2-1
Historical Estimates of Sediment Transport at the Mouth of Canyon Creek, Based on Discharge Estimates Derived From Placer Creek and Sediment Transport Data From Canyon Creek, Water Year 1999

Year	Sands (tons)	Fines (tons)	Bedload (tons)	Total (tons)
1990	560	810	41	1400
1991	880	2300	86	3200
1992	93	59	4	160
1993	230	270	15	520
1994	100	92	6	200
1995	440	880	37	1400
1997	1500	4500	160	6200
Yearly Average of Sediment Transport				2400

4.0 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination and mass loading in the five segments of the Canyon Creek watershed are discussed in this section. Section 4.1 describes chemical concentrations found in environmental media, including horizontal and vertical extent. For each watershed segment, the discussion includes remedial investigation data chemical analysis results; comparison of chemical results to selected screening levels (Part 1, Section 5.1); and focused analysis of identified source areas. In Section 4.2, preliminary estimates of mass loading are presented.

4.1 NATURE AND EXTENT

The nature and extent of the ten metals of potential concern identified in Part 1, Section 5.1 (antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, silver, and zinc) in surface soil, subsurface soil, sediment, groundwater and surface water are discussed in this section. Locations with metals detected in any matrix at concentrations 1 times (1x), 10 times (10x) and 100 times (100x) the screening level were identified. The magnitudes of exceedance (10x and 100x) were arbitrarily selected to delineate areas of contamination.

The screening levels used in this evaluation were selected from applicable risk-based screening criteria and available background concentrations. Proposed screening levels were compiled from available federal numeric criteria (e.g., National Ambient Water Quality Criteria), regional preliminary remediation goals (PRGs) (e.g., U.S. EPA Region IX PRGs), regional baseline or background studies for soil, sediment, and surface water, and other guidance documents (e.g., National Oceanographic and Atmospheric Administration freshwater sediment screening values). The screening level selection process is discussed in detail in Part 1, Section 5.1. Screening levels are used in this analysis to identify source areas and media (e.g., soil, sediment, groundwater, and surface water) of concern that will be evaluated in the feasibility study (FS).

Historical and recent investigations at areas within the study area are listed and summarized in Part 1, Section 4. Data source references are included as Attachment 1. Chemical data collected in Canyon Creek and used in this evaluation are presented at the end of this report. Data summary tables include sampling location, data source reference, collection date, depth, and reported concentration. Screening level exceedances are highlighted. Sampling locations are shown on Figures 4.1-1 through 4.1-13. Major source areas are shown in detail in Figures 4.1-14 through 4.1-40. All chemical data collected and compiled for Canyon Creek are included in Attachment 2.

Statistical summaries for each metal in surface soil, subsurface soil, sediment, groundwater, and surface water are included as Attachment 3 and discussed in the subsections below. The summaries include the number of samples analyzed; the number of detections; the minimum and maximum detected concentrations; the average and coefficient of variation; and the screening level (SL) to which the detected concentration is compared.

Source areas within Canyon Creek are listed in Tables 4.1-1 through 4.1-5. These tables are based on source areas initially identified by the BLM (1999) and further refined by CH2MHILL and URS during the remedial investigation/feasibility study (RI/FS) process. The tables include source area names, source area ID, source area acres, description, the number of samples collected from within each source area listed by matrix type, and metals exceeding 1x, 10x and 100x the screening levels in surface soil, subsurface soil, sediment, groundwater, and surface water. The tables reflect source area descriptive measurements initially generated in the CSM and subsequently refined by the FS.

It should be noted that the number of samples identified for each source area was determined using the project Geographical Information System. Only sampling locations located within a source area polygon (shown on Figures 4.1-1 and 4.1-2) are included in Table 4.1-1; therefore, there may be samples collected from source areas and listed in the data summary tables in Attachment 2 that are not accounted for in Table 4.1-1.

The following sections present segment-specific sampling efforts and results according to matrix type. Given the extensive geographic range of the Coeur d'Alene Basin, sampling efforts were focused on areas of potential concern; therefore, more samples were collected from known mining-impacted areas near the creek, than from other areas within the watershed.

4.1.1 Segment CCSeg01

4.1.1.1 Surface Water

Seven surface water samples were collected and analyzed for total and dissolved metals in segment CCSeg01. Copper was detected at a concentration greater than 10x the screening level for total metals. Concentrations for dissolved metals did not exceed screening levels for any samples collected in this segment.

4.1.1.2 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, groundwater, and surface water were reviewed together to identify source areas within segment CCSeg01 that may be significant contributors of metals to Canyon Creek. Summary source area data are presented in Table 4.1-1. Three of the 19 source areas in this segment were sampled for surface water. Chemical concentrations did not exceed 10x the screening levels at any sampling location.

4.1.2 Segment CCSeg02

4.1.2.1 Surface Soil

Thirteen surface soil samples were collected from a depth of 0 to 0.5 feet and analyzed for total metals. Lead exceeded 10x the screening level at one sampling location.

4.1.2.2 Subsurface Soil

Three subsurface soil samples were collected and analyzed for total metals. Zinc and lead exceeded 10x the screening levels at one sampling location.

4.1.2.3 Sediment

Three sediment samples were collected and analyzed for total metals. Silver exceeded 10x the screening level at one sampling location.

4.1.2.4 Groundwater

Two groundwater samples were collected and analyzed for total and dissolved metals. Zinc exceeded 10x the screening level for both total and dissolved metals at one sampling location.

4.1.2.5 Surface Water

Fifty-five surface water samples were collected and analyzed for total metals and 56 for dissolved metals. Total and dissolved metal concentrations in surface water were all less than 10x the screening level.

4.1.2.6 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, groundwater, and surface water were reviewed together to identify source areas within segment CCSeg02 that may be significant contributors of metals to Canyon Creek. Summary source area data are presented in Table 4.1-2. Three of the 14 source areas in this segment were sampled for surface soil, and a fourth source area was sampled for groundwater, subsurface soil, surface soil and surface water. Zinc and lead concentrations in soil and groundwater collected from the impacted floodplain exceeded 10x the screening levels.

4.1.3 Segment CCSeg03

4.1.3.1 Surface Soil

Twelve surface soil samples were collected from a depth of 0 to 0.5 feet and analyzed for total metals. One sampling location exhibited lead and zinc concentrations in excess of 10x the screening level. Lead concentrations were greater than 10x the screening level at three additional locations.

4.1.3.2 Groundwater

Two groundwater samples were collected and analyzed for total and dissolved metals. Concentrations were all less than 10x the screening levels.

4.1.3.3 Surface Water

Six surface water samples were collected and analyzed for total and dissolved metals. Results for total metals indicate antimony and lead concentrations greater than 10x the screening levels at one location. Results for dissolved metals indicate antimony and lead concentrations in excess of 10x the screening levels.

4.1.3.4 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, groundwater, and surface water were reviewed together to identify source areas within segment CCSeg03 that may be significant contributors of metals to Canyon Creek. Summary source area data are presented in Table 4.1-3.

Three of the 20 source areas in segment CCSeg03 were sampled. Lead and zinc surface soil concentrations at Hercules No. 4 were detected in excess of 10x the screening levels. Antimony and lead were detected at the Gorge Gulch Impacted Riparian source area at concentrations in excess of 10x the screening levels.

4.1.4 Segment CCSeg04

4.1.4.1 Surface Soil

Eighty-five surface soil samples were collected from a depth of 0 to 0.5 feet and analyzed for total metals. Arsenic, cadmium, copper, lead, and zinc concentrations were greater than 10x the screening levels. Arsenic, lead, and zinc were detected at greater than 100x the screening levels at one to many locations.

4.1.4.2 Subsurface Soil

Thirty-two subsurface soil samples were collected and analyzed for total metals. Antimony, cadmium, lead, and zinc were detected at concentrations greater than 10x the screening level. Lead and zinc were also detected at concentrations greater than 100x the screening levels in the subsurface soil in two samples.

4.1.4.3 Sediment

Seven sediment samples were collected and analyzed for total metals. Antimony, cadmium, lead, mercury, and zinc concentrations were greater than 10x the screening levels. Lead and zinc concentrations were greater than 100x the screening levels.

4.1.4.4 Groundwater

Fifty groundwater samples were collected and analyzed for total and dissolved metals. Dissolved metal concentrations of cadmium, lead, and zinc were detected at 10x the screening level at several locations. Cadmium, lead and zinc were also detected in several samples at concentrations greater than 100x the screening level for dissolved metals. Total metal concentrations for cadmium, copper, iron, lead, manganese, and zinc were greater than 10x the screening levels at several locations. Concentrations of cadmium and zinc were greater than 100x the screening levels at several locations.

4.1.4.5 Surface Water

Two hundred and forty-four surface water samples were collected and analyzed for total metals and 240 for dissolved metals. Analysis of total metals indicates at least one sample each with concentrations of cadmium, copper, iron, lead, manganese, and zinc greater than 10x the screening levels. Concentrations of copper, lead, manganese, and zinc were greater than 100x the screening levels. Surface water samples for dissolved metals indicated concentrations greater than 10x the screening levels for cadmium, lead, manganese and zinc at several to many sampling locations. Cadmium, lead, manganese and zinc were also detected in several samples at concentrations greater than 100x the screening levels for dissolved metals.

4.1.4.6 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, groundwater, and surface water were reviewed together to identify source areas within segment CCSeg04 that may be significant contributors of metals to the Canyon Creek Watershed. Summary source area data are presented in Table 4.1-4.

Ten of the 62 source areas in this segment were sampled. Numerous source areas detected cadmium, arsenic, lead, and zinc in excess of the 100x screening levels. Additional source areas showed concentrations of antimony, arsenic, cadmium, copper, lead, and zinc greater than 10x the screening levels.

4.1.4.7 Major Source Areas

Based on a cumulative assessment of chemical data for surface soil, subsurface soil, sediment, groundwater, and surface water (URS 2000, Appendix G), major source areas of concern were initially identified. The technical memorandum identified discrete mine/mill sites and tailings impoundments. Evaluation of potential source areas conducted for this RI/FS resulted in addition of floodplain reaches and other specific source areas. The seven major source areas identified in this segment include the following:

- Tamarack No. 7 (1200 level)
- Hercules No. 5 (also included in CCSeg03)
- Frisco/Black Bear
- Hecla-Star Complex/Tiger Poorman/Hidden Treasure
- Gem No. 3 and Gem Millsite

- Standard Mammoth Area (Avalanche Gulch)
- CCSeg04 Impacted Floodplain and Riparian

These source areas are known to have high concentrations of metals resulting from historical mining activities. Figures 4.1-14 through 4.1-21 illustrate significant features of the above source areas. Common features highlighted in the figures include: tailing piles, waste rock piles, mine adits of known location, mining and mill-related structures, residential properties, the river, major roads and additional site-specific details. Major source areas identified in floodplains were mapped at a larger scale (Figures 4.1-20 and 4.1-21) than the figures depicting discrete source areas (Figures 4.1-14 through 4.1-19). Both Figures 4.1-20 and 4.1-21 illustrate regional location, the river and associated floodplains, and towns. Figure 4.1-20 includes the source area boundary as provided by the BLM for CCSeg04 Impacted Floodplain Reaches, and Figure 4.1-21 includes surficial geology units obtained from the U.S. Geological Survey (Box et al. 1999). Based on a comprehensive list created by Box et al. 1999, seven surficial geologic units of interest were identified and combined into a single area for this report. The seven geologic units include the following:

- Fcgos: Flotation-era channel gravels and overlying overbank sediments
- JFti: Jig- and early flotation-era tailings impoundments
- JFms: Jig- and early flotation-era ore concentration millsite
- Joscu: Jig-era overbank sediments, copper impacted
- Jos: Jig-era overbank sediments over pre-mining channel gravel
- Jcgos: Jig-era channel gravels and overlying jig-era overbank sands
- Jrrf: Jig-era railroad embankment fill

These geologic units form the basis of estimates contaminated sediment volumes within the historical floodplain. Volume estimates are included in the Feasibility Study (URS 2001).

Representative site photographs for select source areas are attached (Figures 4.1-25 through 4.1-40).

4.1.5 Segment CCSeg05

4.1.5.1 Surface Soil

Forty-five surface soil samples were collected from a depth of 0 to 0.5 feet and analyzed for total metals. Cadmium, lead and zinc were detected at concentrations in the surface soil that exceeded

10x the screening levels at several to many locations. Lead was also found at concentrations that exceeded 100x the screening levels at four locations.

4.1.5.2 Subsurface Soil

Forty-eight subsurface soil samples were collected and analyzed for total metals. Lead and zinc were detected at concentrations in the subsurface soil that exceeded 10x the screening levels at several locations.

4.1.5.3 Sediment

Nine sediment samples within CCSeg05 were collected and analyzed for total metals. Antimony, cadmium, copper, lead, mercury, silver, and zinc were detected at concentrations that exceeded 10x the screening levels. Lead, mercury, and zinc were detected in excess of 100x the screening level at a few sampling locations.

4.1.5.4 Groundwater

Eighty-eight groundwater samples were collected and analyzed for total metals, and one hundred and eighty-five groundwater samples for dissolved metals. Cadmium, copper, lead, manganese, and zinc were detected at concentrations greater than 10x the screening levels in numerous groundwater samples for total metals. Cadmium, lead, manganese, and zinc were also found at concentrations for total metals greater than 100x the screening levels. Concentrations of dissolved cadmium, copper, lead, manganese, silver, and zinc were detected at concentrations that exceeded 10x the screening levels. Cadmium, lead, manganese, silver, and zinc were also detected at concentrations exceeding 100x the screening levels, with cadmium, lead, and zinc having the highest frequencies of exceedance.

4.1.5.5 Surface Water

Three hundred and forty-seven surface water samples were collected and analyzed for total metals; two hundred and thirty-seven surface water samples were collected and analyzed for dissolved metals. Cadmium, copper, iron, lead, manganese, and zinc were detected at concentrations that exceeded 10x the screening levels for total metals. Cadmium, lead, and zinc were also detected at concentrations exceeding 100x the screening levels at several sampling locations. Surface water also exhibited dissolved concentrations that exceeded 10x the screening level for cadmium, lead, manganese, and zinc and exceeded 100x the screening levels for cadmium, lead, manganese, and zinc.

4.1.5.6 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, groundwater, and surface water were reviewed together to identify source areas within segment CCSeg05 that may be significant contributors of metals to Canyon Creek. Summary source area data are presented in Table 4.1-5.

Five of the twelve source areas in this segment were sampled. The majority of the samples were surface water and groundwater. Concentrations of lead, cadmium, zinc, copper, manganese and silver were detected in most samples, often in excess of 100x the screening levels.

4.1.5.7 Major Source Areas

The two major source areas identified in this segment include:

- Hecla-Star Tailings Ponds
- CCSeg05 Impacted Floodplain and Riparian

These source areas are known to have high concentrations of metals resulting from historical mining activities. Figure 4.1-22 illustrates significant features for the Hecla-Star tailing ponds. Common features highlighted in the figures include: tailing piles, waste rock piles, mine adits of known location, mining and mill-related structures, residential properties, the river, major roads and additional site-specific details.

CCSeg05 Impacted Floodplain Reaches are shown in Figures 4.1-23 and 4.1-24. Major source areas identified in floodplains were mapped at a larger scale than the figures depicting discrete source areas. Both figures illustrate regional location, the river and associated floodplains, and cities. Figure 4.1-23 includes the source area boundary as provided by the BLM for CCSeg05 Impacted Floodplain Reaches and Figure 4.1-24 includes surficial geology units obtained from the U.S. Geological Survey (Box et al. 1999).

4.1.6 Adit and Seep Summary

Most adits and seeps with drainage that have been identified and sampled have flows under 1 cfs and relatively low concentrations of metals. However, very high concentrations of total zinc were measured in two of the adits and two of the seeps identified in the Canyon Creek watershed (Gearheart et al. 1999). A total of twenty-six adits and three seeps were identified. Available adit and seep data for the Canyon Creek watershed are summarized in Table 4.1.6-1. Discharge, average total zinc concentration, average total zinc mass loading, and associated source areas are listed. Zinc mass loading from the Hercules No. 5, Tamarack No. 7, and the Hidden Treasure (Tiger-Poorman) adits and the seeps at the Hecla-Star Tailings Ponds and Canyon Cr. Repository Reach were greater than 1 pound per day. Total zinc mass loading for all adits and seeps identified in the Canyon Creek watershed is estimated to be approximately 45 pounds per day.

4.2 SURFACE WATER MASS LOADING

In Part 1 of this report (Setting and Methodology, Section 5.3.1), the concept of mass loading and its use in the remedial investigation were presented. Past data collection efforts were summarized along with potential data quality issues. Historically, and as part of this study, a large number of sampling events have been conducted to characterize and evaluate the amount of metal being transported in surface water throughout the basin. As discussed in Part 1, some of these sampling events can be considered as synoptic for interpretation of the data. These are usually the low-flow sampling events conducted in late summer, fall, or early winter. Also discussed in Part 1 are the effects that unsteady-state flow conditions have on the measurements and the increased complexity of interpretation.

To address the complexities of interpreting mass loading data, the analysis has been separated into two discussions. This section of the remedial investigation discusses mass loading for total lead and dissolved zinc based on a series of discrete sampling events. To address data variability inherent in discrete measurements, mass loading was also evaluated using a probabilistic model. Modeling results are discussed in Section 5, Fate and Transport.

Total lead and dissolved zinc were selected as reasonable indicators of metal loading in surface water based on correlations with each of the eight other chemicals of potential concern (COPCs) (discussed in Section 4.2.1). In this section, the locations sampled during each event are plotted on a map of the watershed (Figures 4.2-1 through 4.2-10). Each sampling location shows the cumulative mass loading of lead or zinc and the difference in mass load from the next upstream location. The difference in mass load is indicated on the maps by the term "delta." If no uncertainty (natural conditions or measurement factors) were present in the data, this would be the mass load added between the two locations. Presenting the data in this manner allows a qualitative comparison between different sampling events such that trends may be observed and general conclusions made. It also allows comparison of the relative mass loading in portions of the stream system even though the same sampling locations were not consistently sampled from event to event.

As an example, comparison of flow sampling events may identify watershed segments in which the differences in mass load of total lead remain relatively low from year to year. This would indicate that under varying flow conditions, mine waste, if present, might not be a source of

significant lead loading to the stream system. Conversely, consistently high differences in mass load would indicate areas of potential loading.

This approach does not, however, address the variations in mass loading that can occur over short time periods during non-steady flow conditions, variability in stream gauging measurements, hysteresis effects, losing or gaining stream segments, localized disturbances in the stream channel prior to a sampling event, or other factors that can impact the interpretation of the data. To account for the potential measurement errors and natural variability in the stream system, a probabilistic mass loading model was developed.

Development of the model is discussed in Part 1, Section 5. The model uses as input data from sampling locations in each watershed that have a minimum number of historical measurements. While this approach will incorporate fewer sample locations compared to plotting an individual sampling event, it helps provide a uniform basis that accounts for variability in the sampling data and allows for a more reliable quantitative analysis of the data. The model is used extensively in Section 5, Fate and Transport. The remainder of this section presents the indicator metal correlation and selected maps with a discussion of discrete sampling events on a watershed basis.

4.2.1 Indicator Metal Correlations

Linear regression analyses were conducted to estimate the correlation between concentrations of chemicals of concern and concentrations of dissolved zinc and total lead. The purpose of the analyses was to evaluate the use of dissolved zinc concentrations as an indicator of behavior of each dissolved chemical of concern and total lead concentrations as an indicator of behavior of each total chemical of concern.

The use of indicator chemicals helps avoid having to consider each chemical of concern separately. Dissolved zinc and total lead were chosen as indicator chemicals because dissolved zinc is considered the principal dissolved chemical of concern and total lead is considered the principal total chemical of concern.

4.2.1.1 Linear Regression Analysis

Two sets of linear regression analyses were conducted: "dissolved analyses" and "total analyses." The dissolved analyses regressed the dissolved concentration of each chemical against the dissolved concentration of zinc. The total analyses regressed the total concentration of each chemical against the total concentration of lead. Regressions were conducted on linear (un-transformed) concentration data and log-transformed concentration data.

Standard regression techniques based on the ordinary method of least squares were used (Draper and Smith 1966). Analyses were implemented in MS Excel 97.

The database used for the regression analyses was developed from available data in the TDM database and grouped by CSM Unit. For each chemical, only samples having detected dissolved concentrations of both zinc and the specified chemical of concern were included in the dissolved analyses; and only samples having detected total concentrations of both lead and the specified chemical of concern were included in the total analyses. Data sets for mercury and silver were generally inadequate for meaningful analyses. Data for CSM Unit 3 were inadequate for meaningful analyses, except for dissolved cadmium and lead and total cadmium and zinc.

4.2.1.2 Summary of Results

Analysis results are summarized in Table 4.2-1. The results presented here are limited to the following three measures:

- n, number of samples used in each analysis

- r, the calculated correlation coefficient for each analysis. The correlation coefficient measures the degree of linear correlation between the chemical concentration data. A value of zero (r=0) indicates no linear correlation and a value of one (r=1.0) indicates perfect linear correlation

- 1-a, where "a" is the "critical alpha value" for each analysis. Index 1-a is a statistical measure of the probability that there is true correlation (i.e., "true r">0) between the chemicals, considering the effect of both the sample size (n) and the calculated correlation coefficient (r). 1-a is also called the significance or confidence level.

Only results for the log-transformed analyses are included because the transformations typically improved the correlation or otherwise gave results similar to the linear (untransformed) analysis. To minimize cumbersome language, the following discussion of correlations between chemical concentrations tacitly means correlation between the logs of the concentrations.

For dissolved chemical concentrations, the results in Table 4.2-1 indicate that there is generally positive linear correlation with dissolved zinc concentrations (i.e., the logs of the concentrations are correlated). However, the degree of correlation varies from chemical to chemical, as does the consistency of the correlation across CSM Units. That is, relative to dissolved zinc:

- Cadmium is consistently highly to well correlated (r ranges from 0.69 to 0.94)
- Manganese is consistently reasonably well correlated (r ranges from 0.62 to 0.68)
- Lead is well correlated in CSM Unit 1 (r = 0.82), reasonably correlated in CSM Unit 2 (r = 0.59), and marginally correlated in CSM Unit 3 (r = 0.15)
- Arsenic is highly correlated in CSM Unit 2 (r = 0.96), and marginally correlated in CSM Unit 1 (r = 0.12)
- Antimony is somewhat correlated in CSM Unit 1 (r = 0.31) and marginally correlated in CSM Unit 2 (r = 0.18)
- Iron is marginally correlated in CSM Unit 1 (r = 0.18), in CSM Unit 2 (r = 0.10), and reasonably well correlated in CSM Unit 3 (r = 0.60).

As indicated in Table 4.2-1, there is also a positive correlation pattern for total chemical concentrations relative to total lead concentrations. Although the calculated correlation coefficients vary from chemical to chemical, antimony, arsenic, cadmium, copper, iron, manganese, and zinc are all reasonably well correlated in CSM Units 1 and 2. For CSM Unit 3 there was inadequate data for analysis, except for zinc and cadmium, neither of which shows significant correlation.

These results support using dissolved zinc as an indicator for dissolved chemical concentrations and total lead as an indicator for total chemical concentrations in the upper and midgradient watersheds (CSM Units 1 and 2).

4.2.2 Canyon Creek Watershed Mass Loading

Of the available sampling data, five sampling events were selected and mapped. Table 4.2-2 summarizes the sampling events, sampling locations and calculated mass loads for total lead and dissolved zinc. The low-flow events used were October 1991 (Figures 4.2-1 and 4.2-6), November 1997 (Figures 4.2-2 and 4.2-7), and November 1998 (Figures 4.2-3 and 4.2- 8). The high-flow events used were May 1991 (Figures 4.2-4 and 4.2-9) and May 1998 (Figures 4.2-5 and 4.2-10). The following sections discuss observations made from plotting the low- and high-flow mass loading data.

4.2.2.1 Total Lead Mass Loading

Loading observations are as follows:

1. Location CC276 is located downstream of segments CCSeg01, CCSeg02 and CCSeg03. As shown on Figures 4.2-1, 4.2-2, and 4.2-3, this sampling location has a mass load of less than 1 pound per day of lead for all three low-flow sampling events. Figures 4.2-4 and 4.2-5 show that during high flow, lead concentrations were low upstream of CC276 with the 2 pounds per day at CC392 (Gorge Gulch) the highest load measured. While several mine-waste sources are present, the data do not indicate substantial lead contributions are occurring in these segments.

2. In segment CCSeg04, between CC276 and CC279, differences in lead mass loading at low-flow were less than 1 pound per day. During high-flow events, differences in lead mass loading varied from –104 to 66 pounds per day. There is insufficient data to explain the large negative difference observed near Mace during a high-flow sampling event. Mine workings associated with the Hercules No 5, Tiger-Poorman and Hecla-Star Mine & Millsite are the potential mine sources located upstream of the high lead differences observed at high flow. Additionally, resuspension of impacted floodplain sediments may be a source of total lead in this reach.

3. Downstream of CC279 to the lower boundary of CCSeg04 the low-flow differences in lead mass loading ranged from –4 to 13 pounds per day. The highest downstream cumulative low-flow loading observed was at CC484 (November 1998) at 43 pounds per day. High-flow lead differences ranged from –11 to 14 pounds per day.

Under high-flow conditions, there is an increase in lead loading starting downstream of the Tamarack No. 7. Locations CC282 and CC15 are the most downstream locations in the segment. The loading at these locations are 42 and 22 pounds per day, respectively. Mines that are likely sources for the increased lead loading include the Tamarack No. 7, Frisco, Black Bear Fraction, and Gem Millsite. These mines along with the Tiger-Poorman, Hecla, Sherman, and Granite Mills also were sources of mine material now present in the flood plain alluvium. This material is also considered a source of lead loading in segment CCSeg04.

4. Lead loading in segment CCSeg05 is variable. The low-flow sampling had loads that ranged from 3 to 85 pounds per day. During high flow, the loads ranged from 19 to 64 pounds per day. While there is a large variability in load, the high flow events indicate that loads discharged to the South Fork were between 29 and 64 pounds per day of lead.

   The interaction between surface water and groundwater in this segment is complex. The USGS conducted a seepage study in the Woodland Park Area (USGS 2000). Results of this study indicate a high degree of interchange between surface water and groundwater. The Star-Morning Tailings Ponds and the SVNRT tailings repository are the dominant mining features in the floodplain. The Standard-Mammoth Mill Site is located close to the mouth of Canyon Creek. Remediation activities of the floodplain have disturbed the upper half of segment CCSeg05. Given the disturbance of the channel, it is difficult to establish a trend for lead loading in the segment.

In summary, the low- and high-flow events that were plotted indicate that mass loading of lead varies considerably. Most of the lead load is introduced in segments CCSeg04 and CCSeg05. Total lead loads can be much larger at high discharges. Total lead loads as high as 4,100 pounds per day (May 24, 1999) have been measured at the mouth of Canyon Creek. Inspection of the discrete measurements gives a qualitative indication of which mine source areas may be introducing metal load into the surface water. However, this analysis of discrete measurement data illustrates the wide variability in mass loading data. Because of this variability, mass loading is also evaluated using a probabilistic model. Model results are discussed in the fate and transport section.

4.2.2.2 Dissolved Zinc Mass Loading

Loading observations are as follows:

1. Location CC276 is located downstream of segments CCSeg01, CCSeg02 and CCSeg03. As shown on Figures 4.2-6 through 4.2-8, the highest low-flow cumulative loading at this location was 5 pounds per day. Figures 4.2-9 and 4.2-10 show that during high flow, dissolved zinc loading increased. Again using CC276 as the downstream station of the three segments, the highest cumulative loading was 31 pounds per day. It is likely that the source of increased loading is the mine waste located near Burke and the Hercules No 5. Adit and potentially impacted floodplain sediments. While several mine waste sources are present upstream, it seems unlikely that they are substantial sources of zinc loading.

2. Segment CCSeg04, between CC276 and CC279 (November 1997), had low-flow differences in mass loading of zinc that ranged from 2 to 38 pounds per day. The cumulative load generally increases downstream. During the high-flow events in this portion of segment CCSeg04, the differences in mass loading of zinc ranged from 18 to 284 pounds per day. Stream flows were higher during the May 1998 event. As shown on Figure 4.2-10 (May 1998), sampling location CC291 has a cumulative load of 371 pounds per day, a difference of 284 pounds per day and a discharge of 274 cubic feet per second. This increase in loading may reflect exceedance of an erosion threshold such as those discussed in McBain and Trush (2000). An erosion threshold is a discharge rate high enough to begin mobilization of large sized sediment particles.

   Sampling location CC291 is downstream of the Standard Mammoth Mine, a possible source of zinc loading. Further upstream, the Hercules No 5, Tiger-Poorman and Hecla-Star Mine & Millsite are also potential sources of mine waste that has been mixed in the alluvium throughout the segment.

3. Downstream of sampling location CC279 to the lower boundary of segment CCSeg04 the low-flow zinc differences ranged from -5 to 62 pounds per day. The highest downstream cumulative low-flow loading observed was at CC484 (November 1998) at 195 pounds per day.

   High-flow zinc differences ranged from -6 to 196 pounds per day. The highest downstream cumulative loading in the segment was 418 pounds per day at CC15 (May 1991). Under high-flow conditions, the zinc loading increases downstream of the

Tamarack No. 7. Mines that are likely sources for the increase in zinc loading in this portion of segment CCSeg04 include the Tamarack No. 7, Frisco, Black Bear Fraction, and Gem Millsite. These mines, along with the Tiger-Poorman, Hecla, Sherman and Granite Mills were also sources of mine material now present in the floodplain alluvium and are also a likely source of metal loading.

4. Zinc loading in segment CCSeg05 at low flow generally increases in the downstream direction. The low-flow sampling in November 1998 had cumulative loads that ranged from 191 (CC454, upstream) to 560 pounds per day (CC288, downstream). During high flow (May 1991), the highest loads ranged from 449 (CC284, upstream) to 880 pounds per day (CC23, downstream). The high-flow sampling indicates that loads discharged in surface water to the South Fork were between 845 and 880 pounds per day of dissolved zinc. Likely sources of zinc loading in this segment include the Hecla-Star Tailings Ponds, the SVNRT repository, and the impacted floodplain.

In summary, the low- and high-flow events that were plotted indicate that mass loading of zinc varies considerably, but generally increases downstream. Most of the zinc load is introduced in segment CCSegs04 (below the Tamarack No. 7) and segment CCSeg05. Above the Tamarack No. 7, the highest low- and high-flow loadings were 65 and 371 pounds per day, respectively. Inspection of the discrete measurements gives a qualitative indication of which mine source areas may be introducing metal load into the surface water. However, this type of interpretation does not take into account wide variability in mass loading data as will the model results discussed in fate and transport.

4.2.2.3 Groundwater Mass Loading

Groundwater associated with tailings-impacted sediments is the primary source of dissolved-phase mass loading in segment CCSeg05. The contribution of groundwater within segment CCSeg05 to mass loading in Canyon Creek was evaluated at nine locations near Woodland Park by the USGS in September and October 1999 (Barton 2000). In September 1999, groundwater contributed an estimated 217 pounds of zinc per day and 2.9 pounds of lead per day to Canyon Creek. In October 1999, groundwater contributed an estimated 229 pounds of zinc per day and 2.2 pounds of lead per day to Canyon Creek.

The mass loading of metals from groundwater at the mouth of Canyon Creek is very small compared to the loading of metals from groundwater to surface water from the wide alluvial floodplain above Woodland Park. Groundwater is released from the alluvial aquifer where bedrock becomes shallow before the mouth of Canyon Creek. Zinc loading in groundwater at the mouth of Canyon Creek in December 1998 was estimated using hydraulic parameters measured in wells in the Woodland Park alluvial aquifer and dissolved zinc concentrations in groundwater samples from wells CC480 and CC481. The following parameters were used to calculate mass loading:

- Hydraulic conductivity = 130 feet per day
- Hydraulic gradient = 0.025 ft/ft
- Aquifer cross section area at mouth of Canyon Creek = approximately 300 square feet
- Dissolved zinc concentration in groundwater = 6,000 µg/L

The estimated dissolved zinc load in groundwater was 0.5 pounds per day. The dissolved zinc load in surface water at the mouth of Canyon Creek was 559 pounds per day. The majority of metal transport is therefore occurring in surface water near the mouth of Canyon Creek. Similar groundwater conditions would be expected at the mouths of other tributaries when shallow bedrock is present and restricts the flow of groundwater.

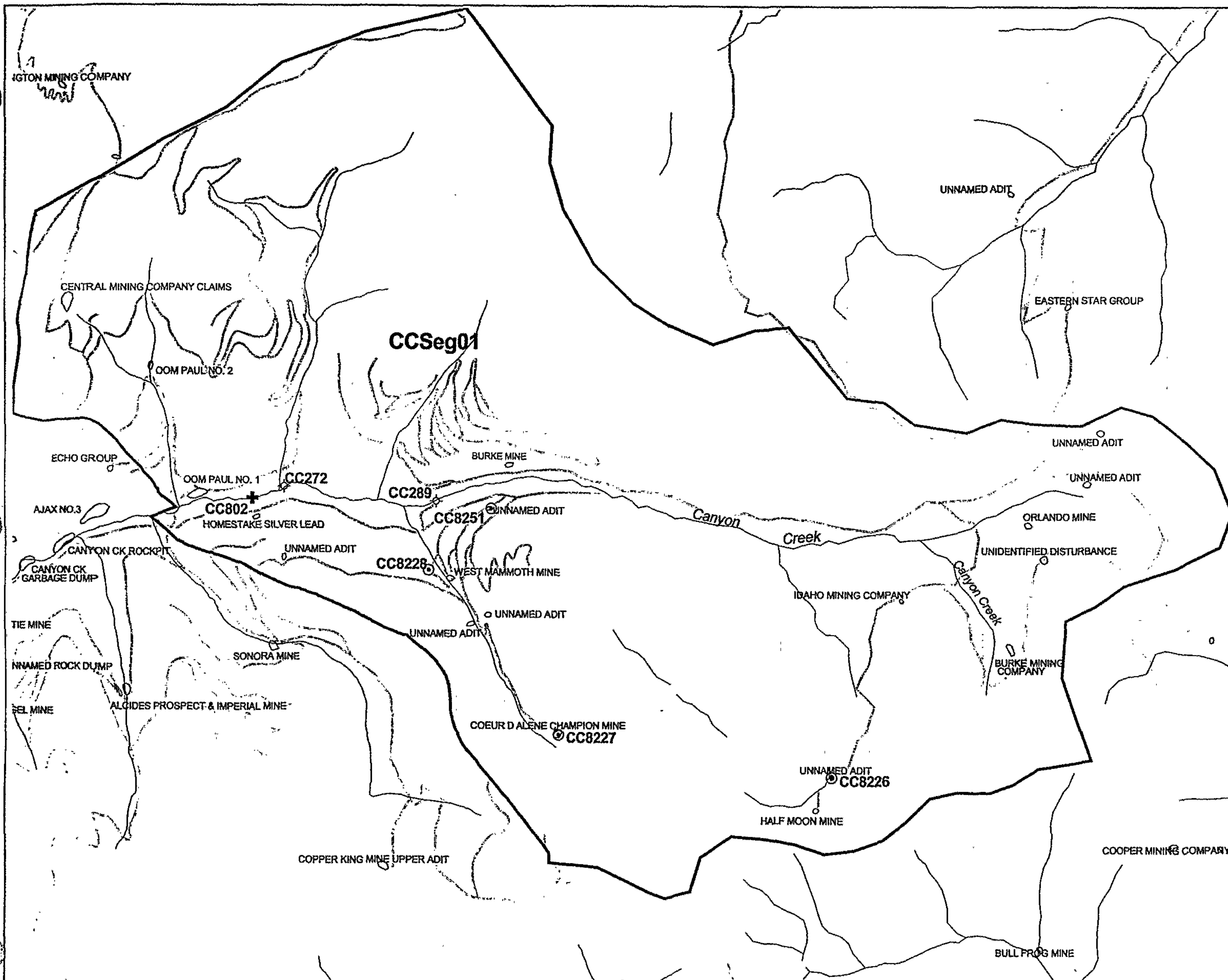


Figure 4.1-1
Canyon Creek Segment CCSeg01
Source Areas and Surface Water Sampling Locations

LEGEND

- Outfall Sampling Location
- River Sampling Location
- Adit Sampling Location
- Stream
- Road
- City
- Canyon Creek Segment 1
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

SCALE 1:24,000

0 0.5 Miles

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05e
Generation 1
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EXTENT:SW
LAYOUT: Final RI CCSeg01 Surface Water Samples 7/19/2001
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This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 19, 2001

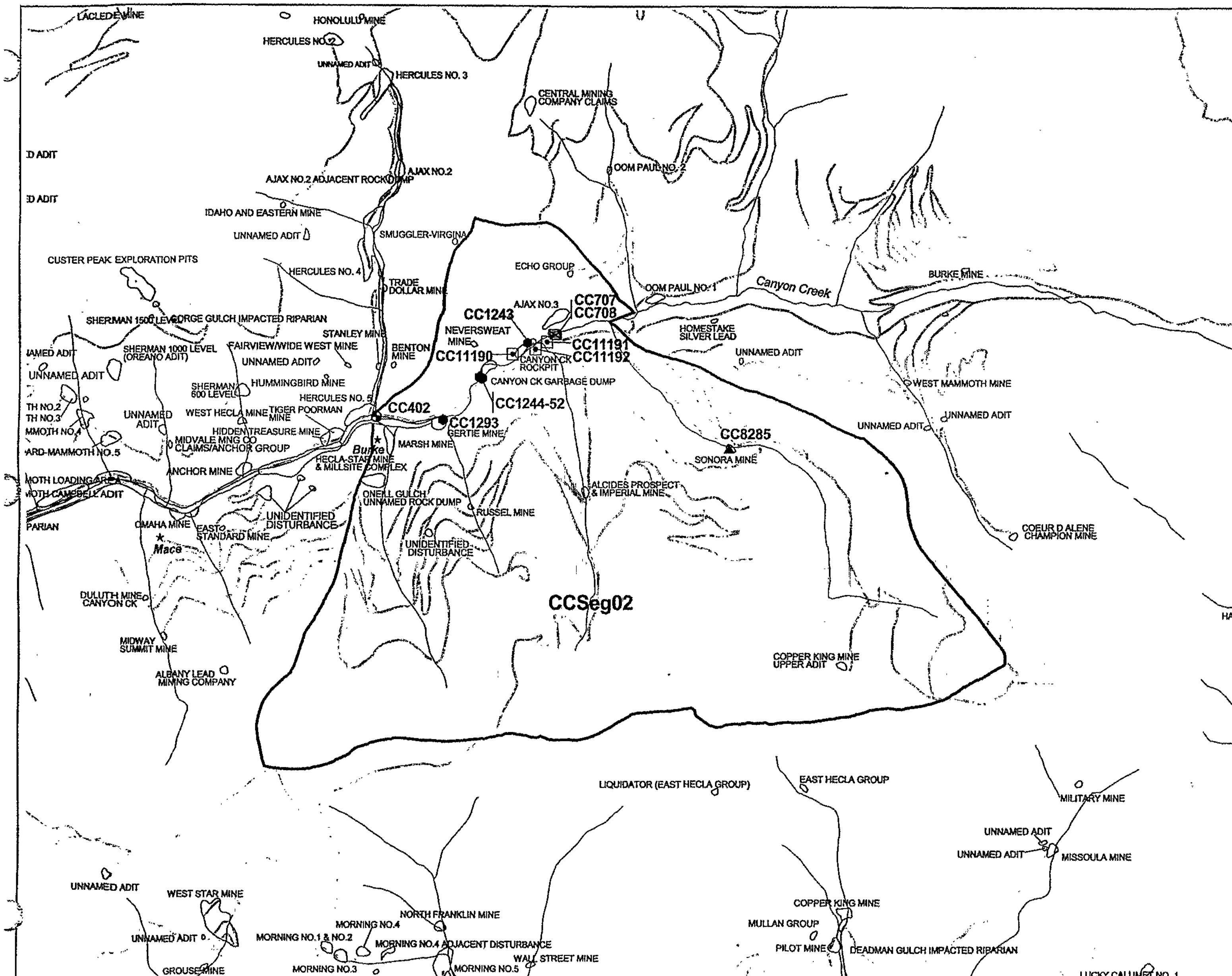

Figure 4.1-2
Canyon Creek River Segment CCSeg02
Source Areas and Soil/Sediment Sampling Locations

LEGEND

- Ground Surface Sampling Location
- Flood Plain Sampling Location
- Monitoring Well Sampling Location
- Test Pit Sampling Location
- Tailings Sampling Location
- Stream
- Road
- City
- Canyon Creek Segment 2
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

SCALE 1:24,000

0 0.5 Miles

N

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05a
Generation 1
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VIEW: CCSeg02 Soil/Sediment Samples
EXTENT:SS
LAYOUT: Final RI CCSeg02_Soil-Sed_Layout
7/18/2001
pdf:Fig4.1-2 CC-Seg02-SS.pdf

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 18, 2001

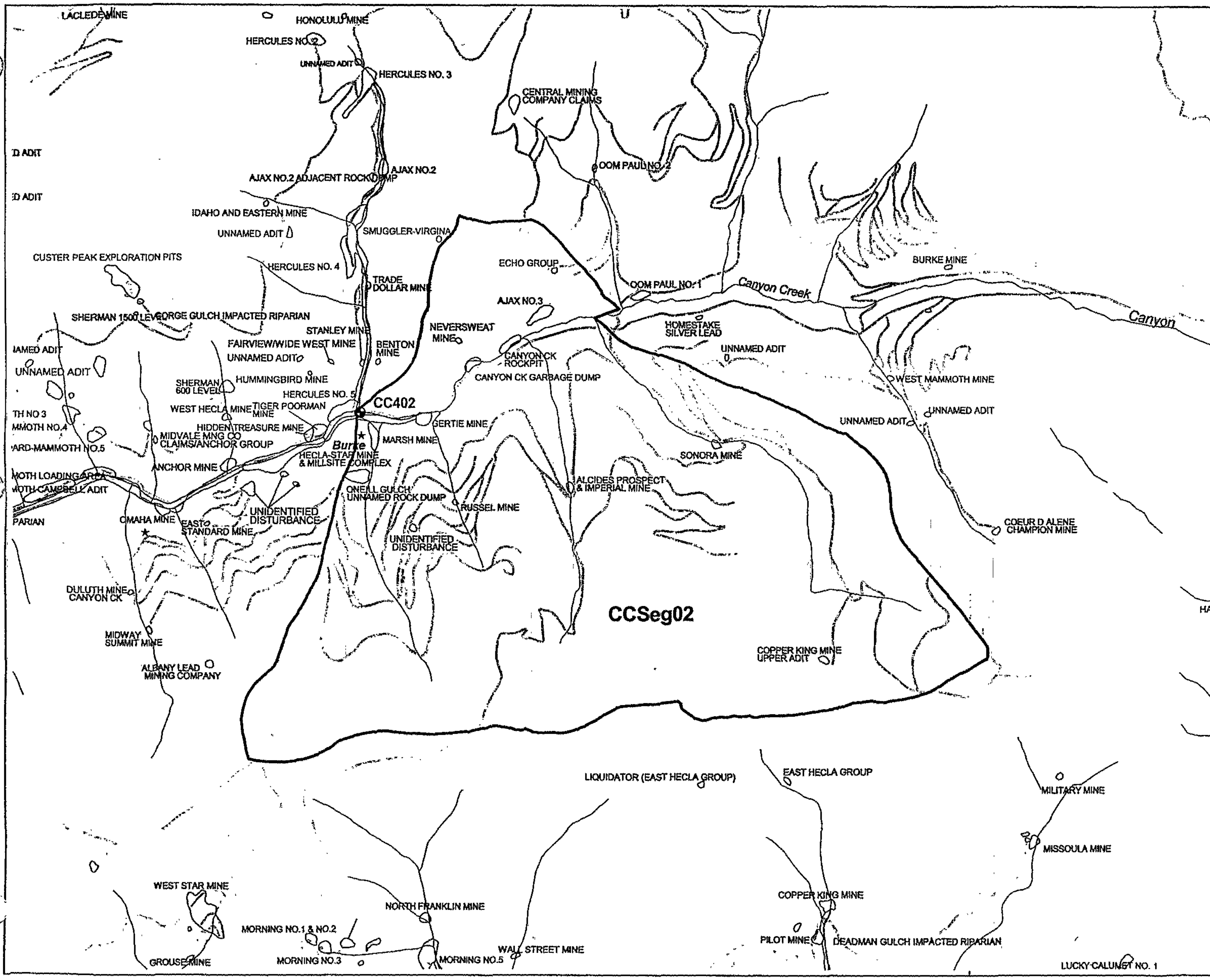

Figure 4.1-3
Canyon Creek Segment CCSeg02
Source Areas and Groundwater Sampling Locations

LEGEND

- Monitoring Well Sampling Location
- Stream
- Road
- City
- Canyon Creek Segment 2
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

SCALE 1:24,000

0 0.5 Miles

N

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05a
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VIEW: CCSeg02 Groundwater Sample
EXTENT: GW
LAYOUT: Final RI CCSeg02_Groundwater_Layout 7/18/2001
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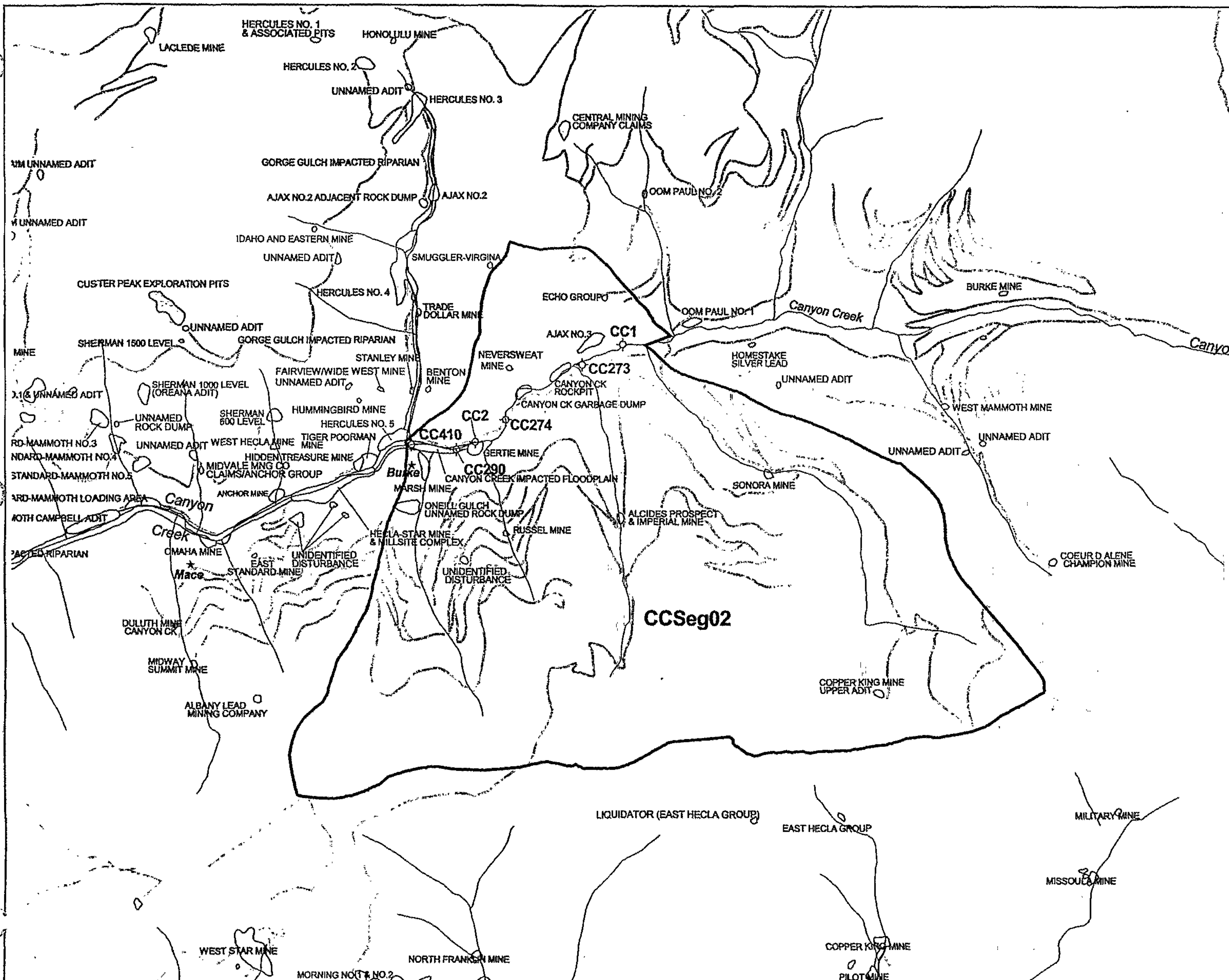

Figure 4.1-4
Canyon Creek Segment CCSeg02
Source Areas and Surface Water Sampling Locations

LEGEND

- River Sampling Location
- Stream
- Road
- City
- Canyon Creek Segment 2
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

SCALE 1:24,000

0 0.5 Miles

N

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05a
Generation 1
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Canyon_Creek_3-29.apr
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EXTENT: SW
LAYOUT: CCSeg02 Surface Water Layout
7/19/2001
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Date of Plot: July 19, 2001

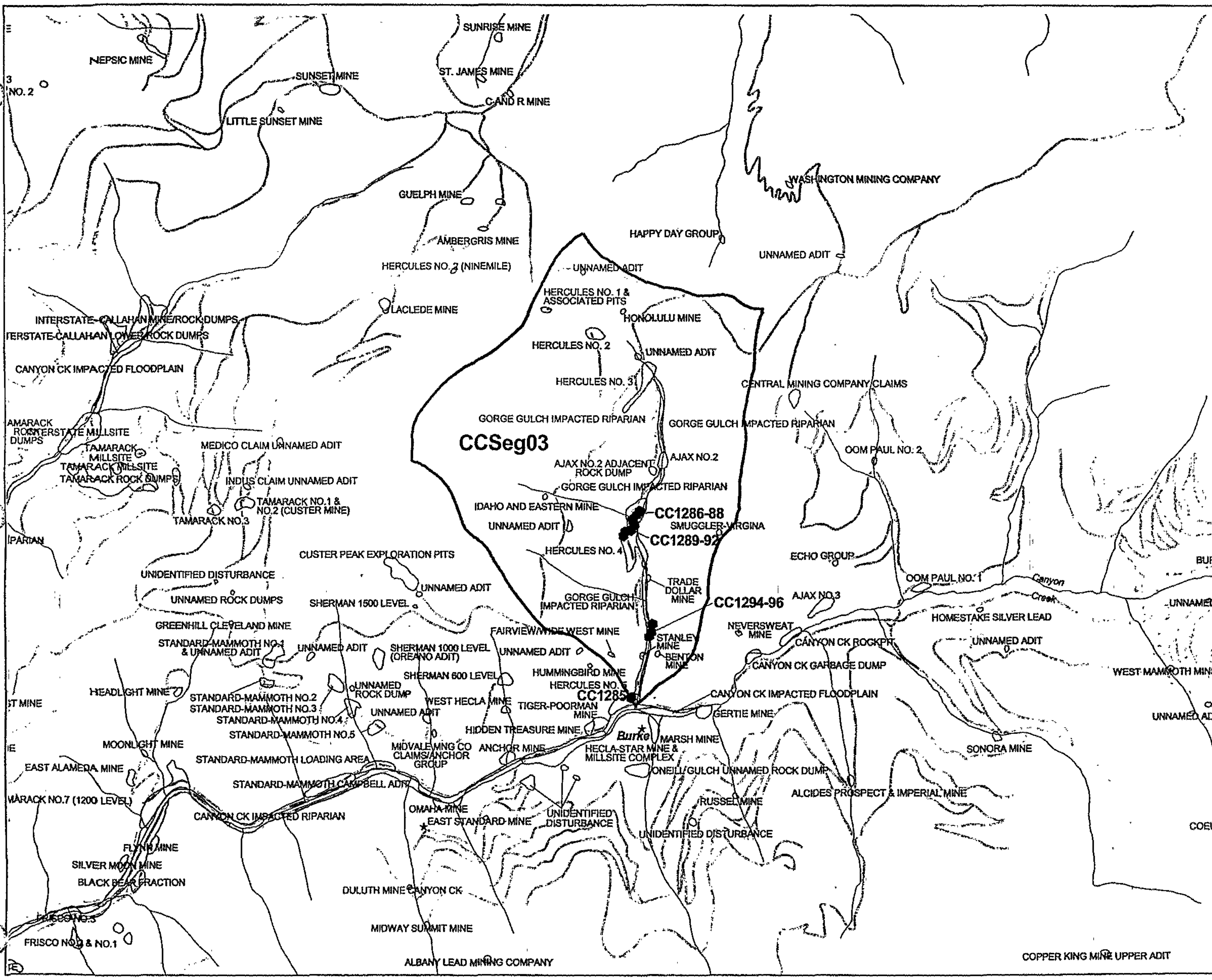
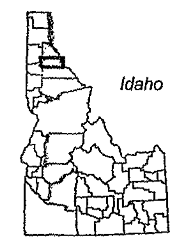


Figure 4.1-5
Canyon Creek Segment CCSeg03 Source Areas and Soil/Sediment Sampling Locations

LEGEND

- Ground/Surface Sampling Location
- Stream
- Road
- City
- Canyon Creek Segment 3
- Source Area and Name



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

SCALE 1:24,000

0 — 0.5 Miles

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control: 4162500.6615.05a
Generation 1
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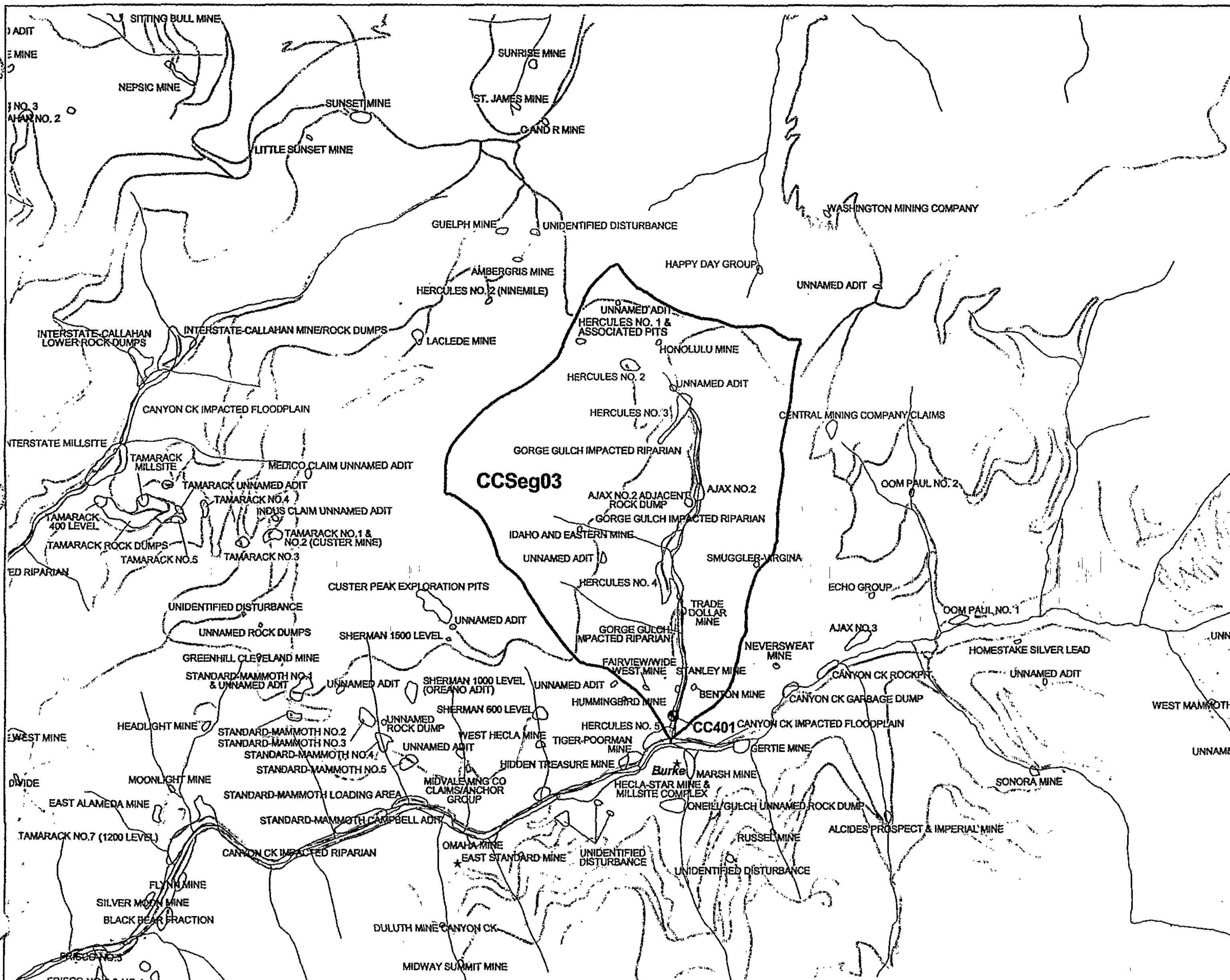
VIEW: CCSeg03 Soil Sediment Samples
EXTENT:SS
LAYOUT: Final RI CCSeg03 Sediment/Soil Layout
7/18/2001
pdf:Fig4.1-5 CCSeg03-SS.pdf

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

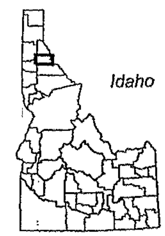
Date of Plot: July 18, 2001

Figure 4.1-6
Canyon Creek Segment CCSeg03 Source Areas and Groundwater Sampling Locations



LEGEND

- Monitoring Well Sampling Location
- Stream
- Road
- City
- Canyon Creek Segment 3
- Source Area and Name



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

SCALE 1:24,000

0 0.5 Miles

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05a
Generation 1
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Canyon_Creek_3-29-00.apr
VIEW: CCSeg03 Groundwater Samples
EXTENT:GW
LAYOUT: Final RI CCSeg03 Groundwater Sample Layout
7/18/2001
pdf:Fig4.1-6 CCSeg03-GW

Date of Plot: July 18, 2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

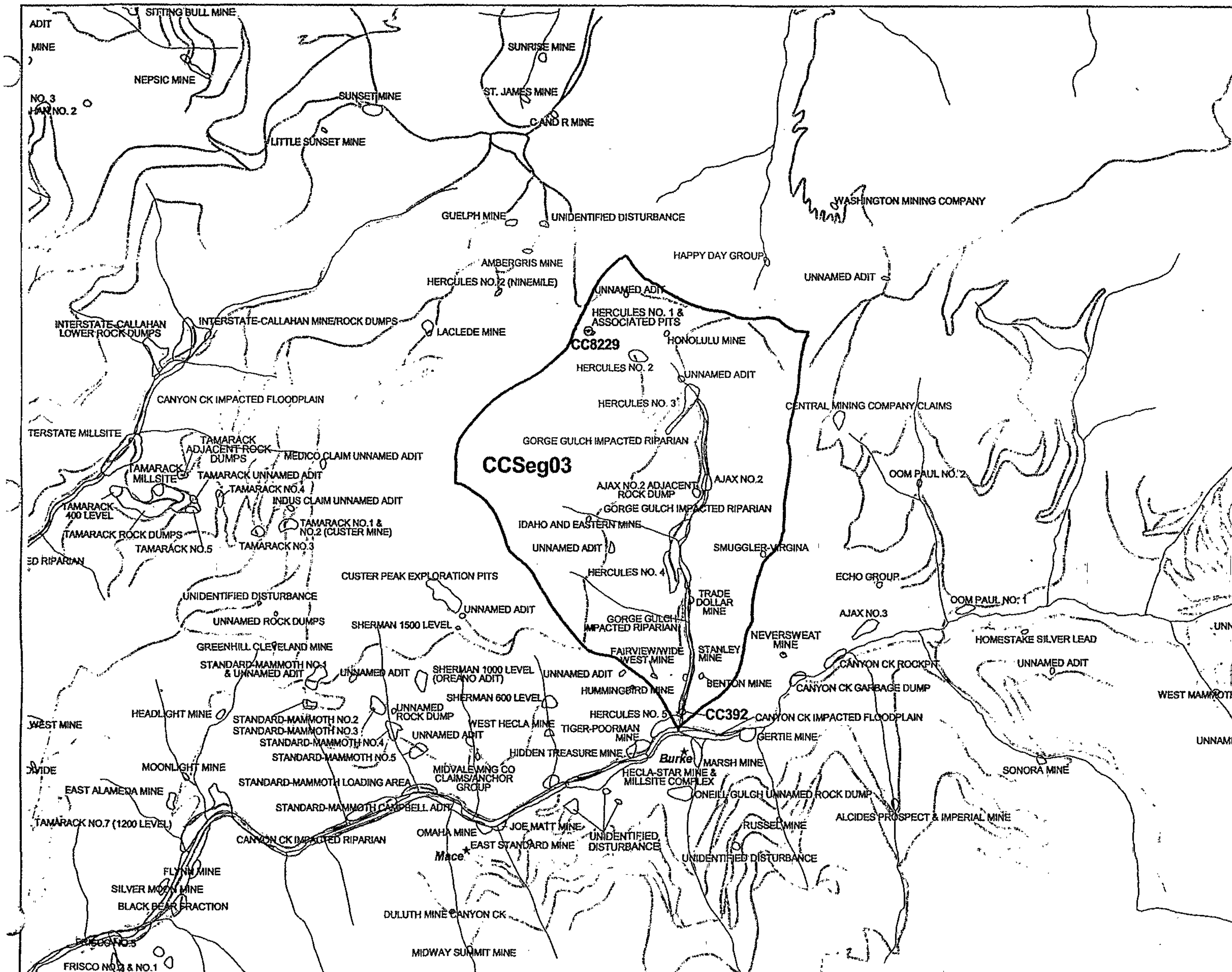

Figure 4.1-7
Canyon Creek Segment CCSeg03 Source Areas and Surface Water Sampling Locations

LEGEND

- Adit Sampling Location
- River Water Sampling Location
- Stream
- Road
- City
- Canyon Creek Segment 3
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

SCALE 1:24,000

0 0.5 Miles

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05a
Generation 1
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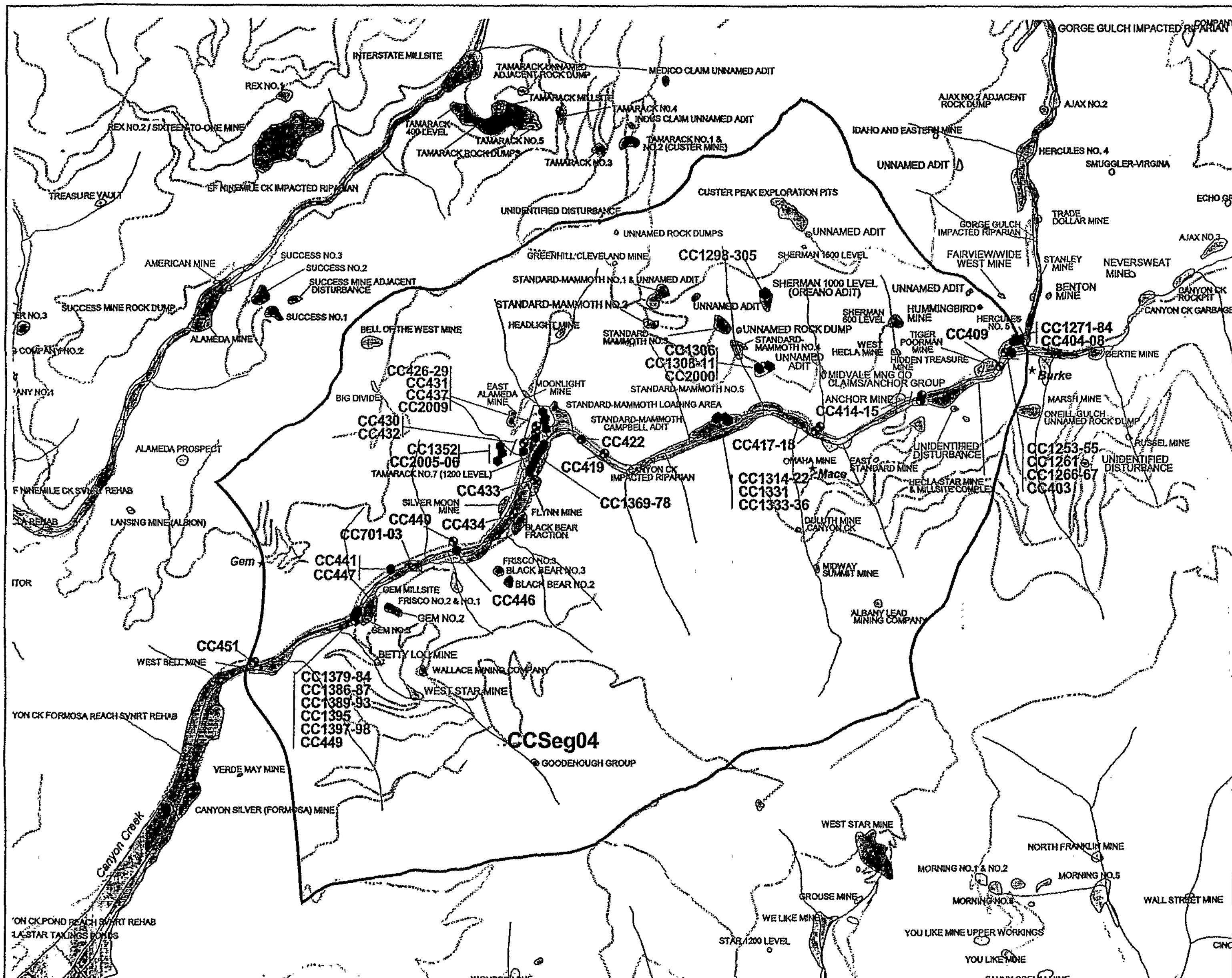
Canyon_Creek_3-29-00.apr
VIEW: CCSeg03 Surface Water Samples View
EXTENT:SW
LAYOUT: Final RI CCSeg03 Surface Water Layout 7/18/2001
pdf:Fig4.1-7 CCSeg03-SW

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 18, 2001

Figure 4.1-8
Canyon Creek Segment CCSeg04 Source Areas and Soil/Sediment Sampling Locations



LEGEND

- Gound Sampling Location
- Monitoring Well Sampling Location
- Test Pit Sampling Location
- Stream
- Road
- City
- Canyon Creek Segment 4
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

SCALE 1:24,000

0 — 0.5 Miles

N

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05.a
Generation 1
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VIEW: CCSeg04 Soil/Sediment Samples
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LAYOUT: CCSeg04 Sediment/Soil
5/18/2000

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Date of Plot: MAY 18, 2000

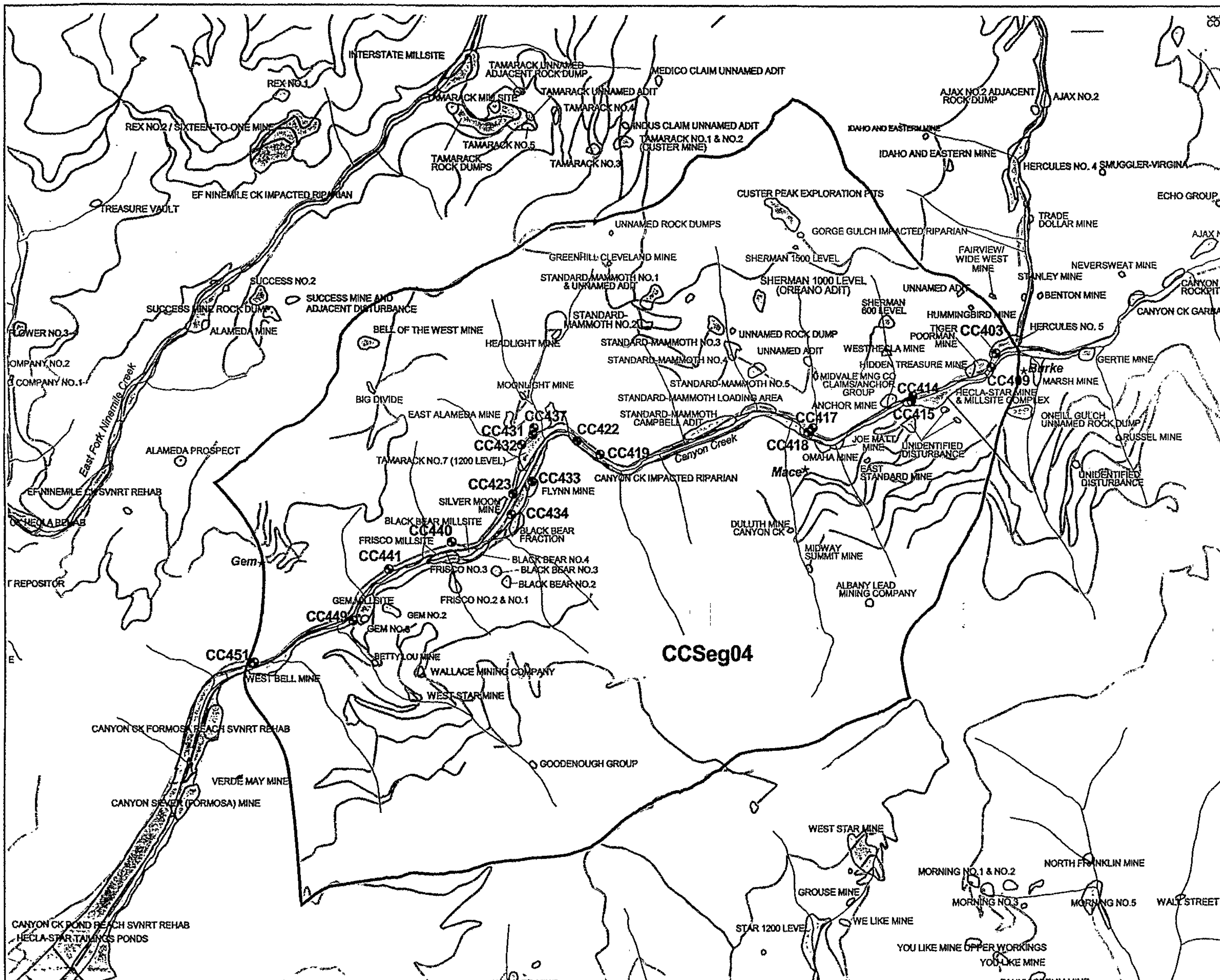
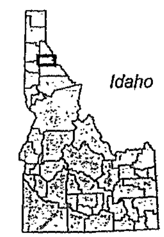


Figure 4.1-9
Canyon Creek Segment CCSeg04 Source Areas and Groundwater Sampling Locations

LEGEND

- Monitoring Well Sampling Location
- Stream
- Road
- City
- Canyon Creek Segment 4
- Source Area and Name



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

SCALE 1:24,000

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027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05.a
Generation 1
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VIEW: CCSeg04 Groundwater Samples View
EXTENT:GW
LAYOUT: CCSeg04 Groundwater Samples
7/31/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: JULY 31, 2001

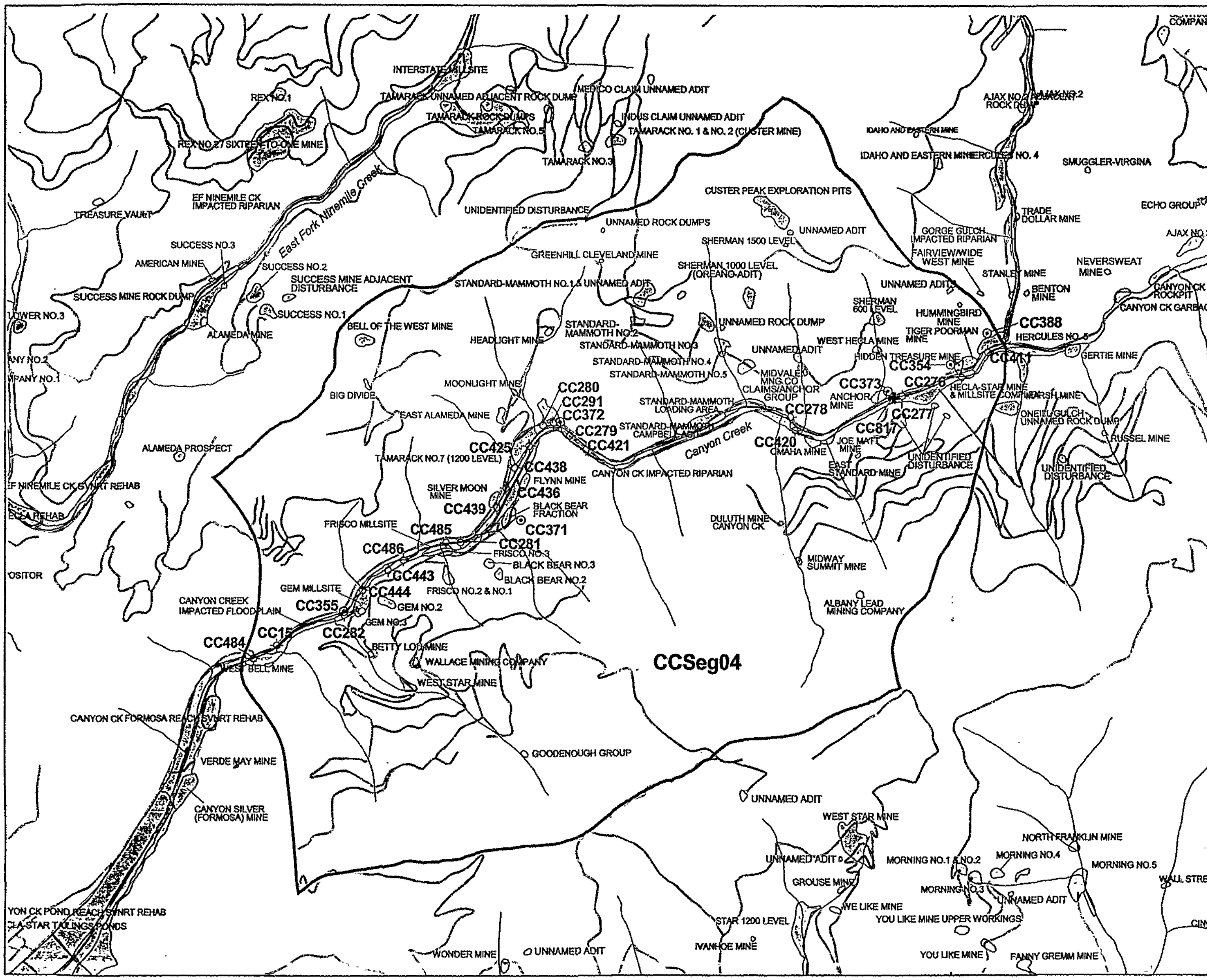
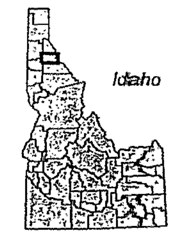


Figure 4.1-10
Canyon Creek Segment CCSeg04
Source Areas and Surface Water Sampling Locations

LEGEND

- Adit Sampling Location
- Outfall Sampling Location
- River Sampling Location
- Stream
- Road
- City
- Canyon Creek Segment 4
- Source Area and Name



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

SCALE 1:24,000

0 — 0.5 Miles

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6615.05.a
Generation 1
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7/31/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: JULY 31, 2001

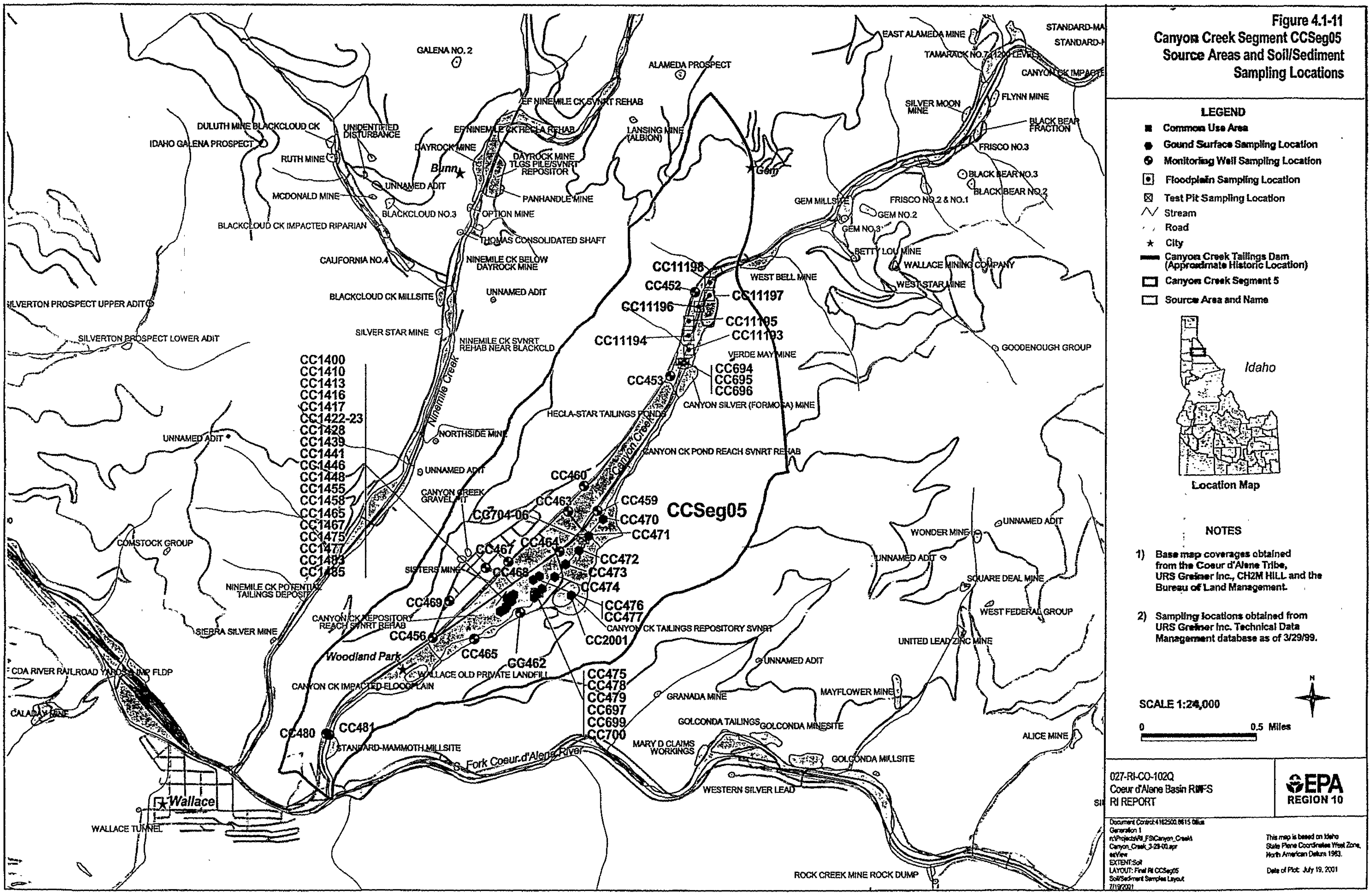

Figure 4.1-11
Canyon Creek Segment CCSeg05
Source Areas and Soil/Sediment
Sampling Locations
LEGEND
Common Use Area
Gound Surface Sampling Location
Monitoring Well Sampling Location
Floodplain Sampling Location
Test Pit Sampling Location
Stream
Road
City
Canyon Creek Tailings Dam (Approximate Historic Location)
Canyon Creek Segment 5
Source Area and Name
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.
2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.
SCALE 1:24,000
0
0.5 Miles
N
027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.
Date of Plot: July 19, 2001
CCSeg05
Canyon Creek
Ninemile Creek
S. Fork Coeur d'Alene River
Wallace
Woodland Park
Gem
Burke
CC1400
CC1410
CC1413
CC1416
CC1417
CC1422-23
CC1428
CC1439
CC1441
CC1446
CC1448
CC1455
CC1458
CC1465
CC1467
CC1475
CC1477
CC1483
CC1485
CC11198
CC452
CC11197
CC11196
CC11195
CC11194
CC11193
CC694
CC695
CC696
CC453
CC460
CC463
CC459
CC470
CC471
CC704-06
CC467
CC464
CC472
CC468
CC473
CC474
CC469
CC476
CC477
CC2001
CC456
CC465
CC462
CC475
CC478
CC479
CC697
CC699
CC700
CC480
CC481
GALENA NO. 2
ALAMEDA PROSPECT
EAST ALAMEDA MINE
TAMARACK NO.7 (1200 LEVEL)
CANYON CK IMPACTE
FLYNN MINE
SILVER MOON MINE
BLACK BEAR FRACTION
FRISCO NO.3
BLACK BEAR NO.3
BLACK BEAR NO.2
FRISCO NO.2 & NO.1
GEM MILLSITE
GEM NO.2
GEM NO.3
BETTY LOU MINE
WALLACE MINING COMPANY
WEST STAR MINE
WEST BELL MINE
EF NINEMILE CK SVNRT REHAB
EF NINEMILE CK HECLA REHAB
LANSING MINE (ALBION)
DULUTH MINE BLACKCLOUD CK
UNIDENTIFIED DISTURBANCE
IDAHO GALENA PROSPECT
RUTH MINE
DAYROCK MINE
DAYROCK MINE TLGS PILE/SVNRT REPOSITOR
UNNAMED ADIT
PANHANDLE MINE
MCDONALD MINE
BLACKCLOUD NO.3
OPTION MINE
BLACKCLOUD CK IMPACTED RIPARIAN
THOMAS CONSOLIDATED SHAFT
CALIFORNIA NO.4
NINEMILE CK BELOW DAYROCK MINE
BLACKCLOUD CK MILLSITE
SILVERTON PROSPECT UPPER ADIT
SILVERTON PROSPECT LOWER ADIT
SILVER STAR MINE
NINEMILE CK SVNRT REHAB NEAR BLACKCLD
VERDE MAY MINE
GOODENOUGH GROUP
HECLA-STAR TAILINGS PONDS
CANYON SILVER (FORMOSA) MINE
NORTHSIDE MINE
CANYON CK POND REACH SVNRT REHAB
CANYON CREEK GRAVEL PIT
COMSTOCK GROUP
SISTERS MINE
NINEMILE CK POTENTIAL TAILINGS DEPOSIT
CANYON CK REPOSITORY REACH SVNRT REHAB
SIERRA SILVER MINE
CANYON CK TAILINGS REPOSITORY SVNRT
WONDER MINE
SQUARE DEAL MINE
WEST FEDERAL GROUP
UNITED LEAD ZINC MINE
CDA RIVER RAILROAD YARDS IMP FLDP
WALLACE OLD PRIVATE LANDFILL
CANYON CK IMPACTED FLOODPLAIN
GRANADA MINE
MAYFLOWER MINE
GOLCONDA TAILINGS
GOLCONDA MINESITE
ALICE MINE
MARY D CLAIMS WORKINGS
GOLCONDA MILLSITE
STANDARD-MAMMOTH MILLSITE
WESTERN SILVER LEAD
WALLACE TUNNEL
ROCK CREEK MINE ROCK DUMP

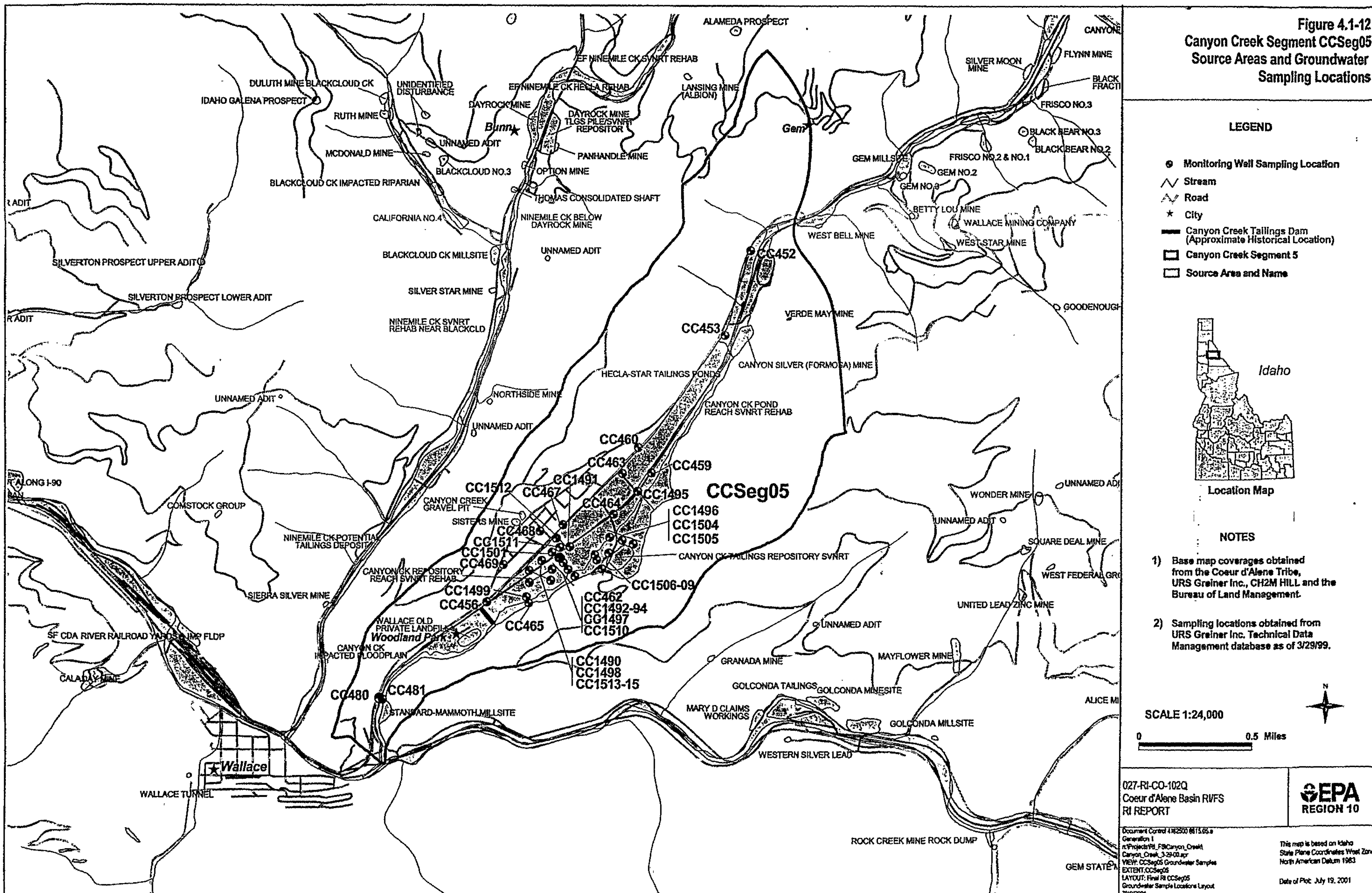

Figure 4.1-12
Canyon Creek Segment CCSeg05 Source Areas and Groundwater Sampling Locations

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner Inc. Technical Data Management database as of 3/29/99.

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 19, 2001

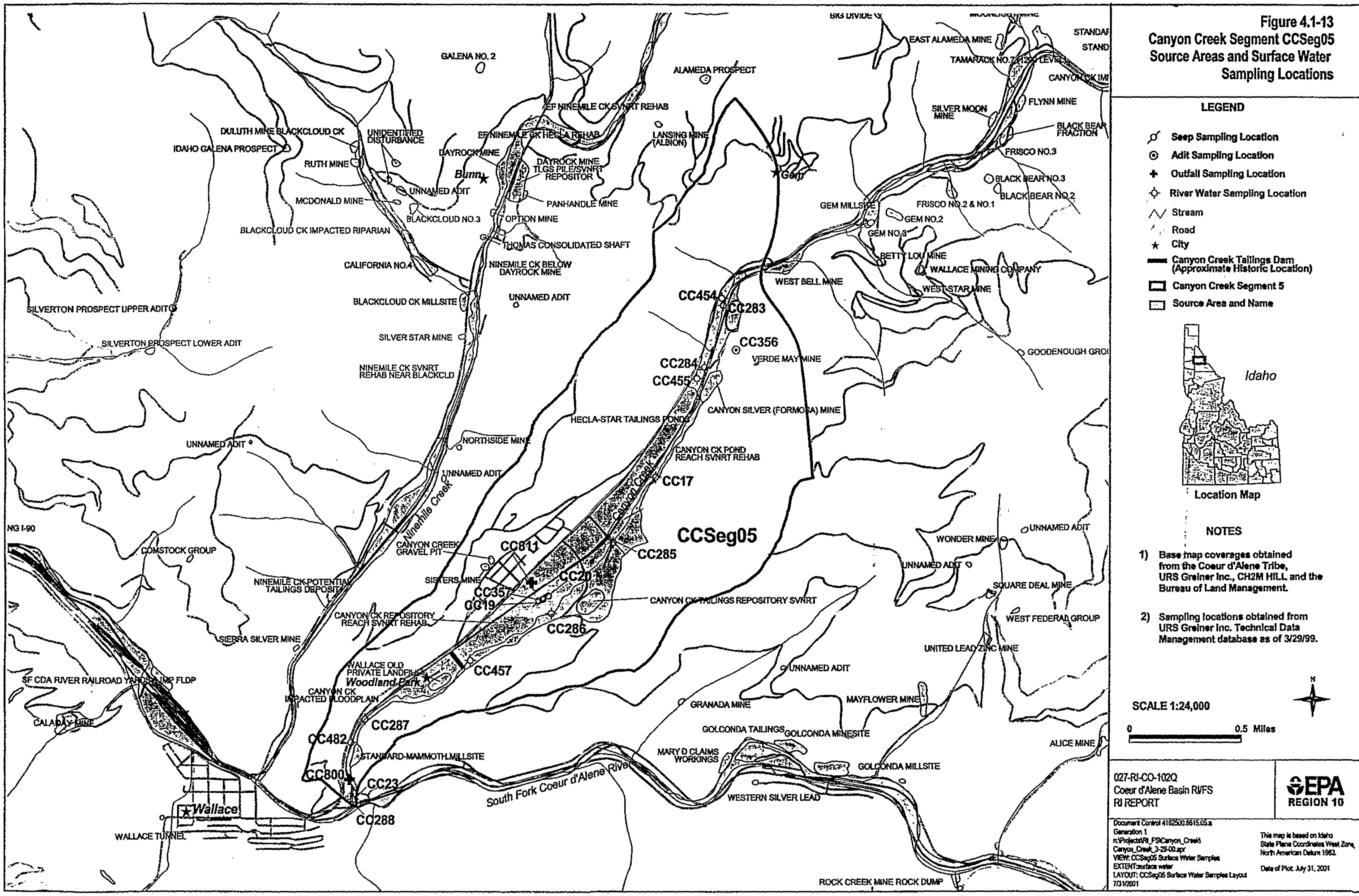

Figure 4.1-13
Canyon Creek Segment CCSeg05
Source Areas and Surface Water
Sampling Locations

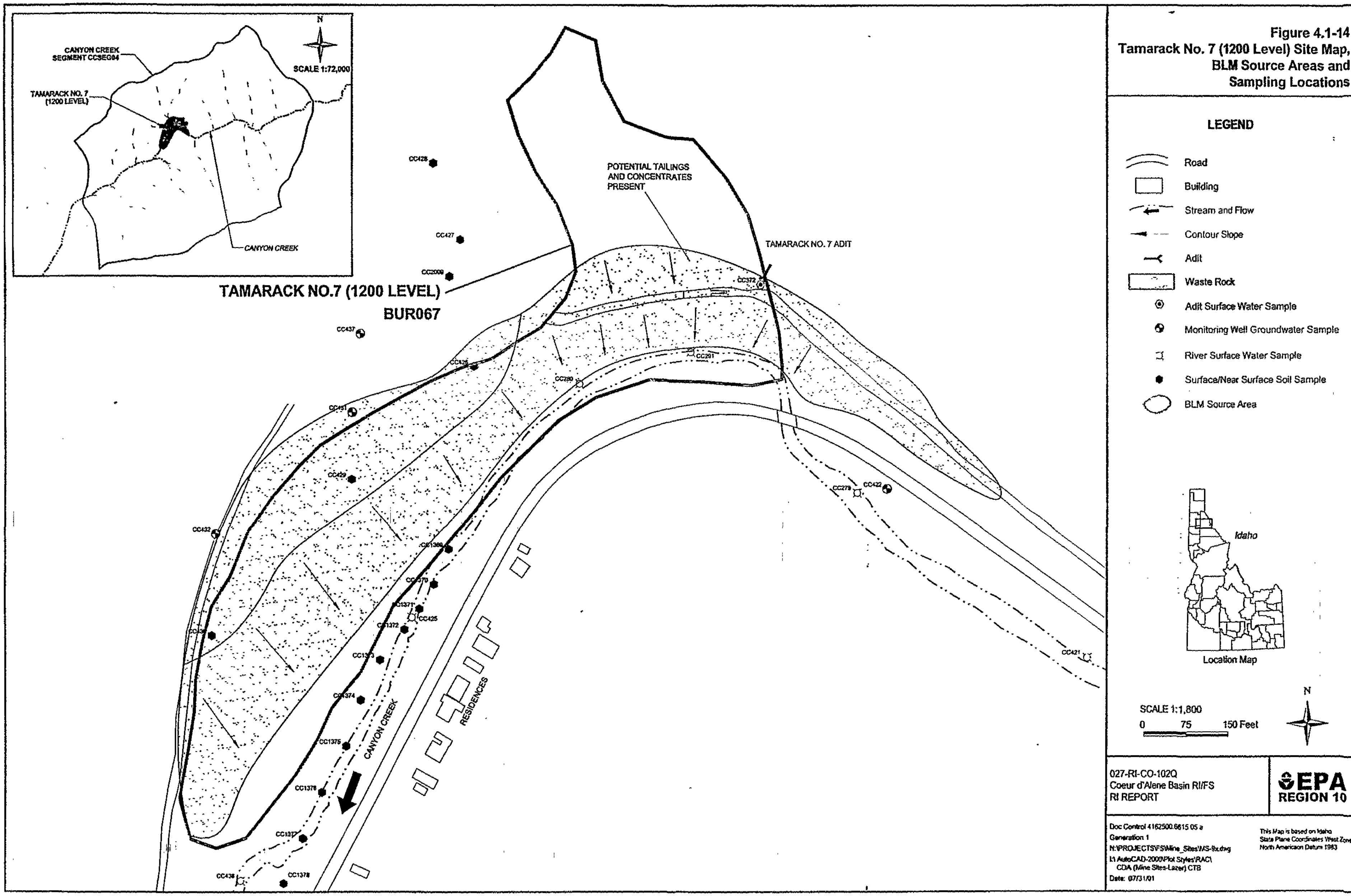

Figure 4.1-14
Tamarack No. 7 (1200 Level) Site Map, BLM Source Areas and Sampling Locations

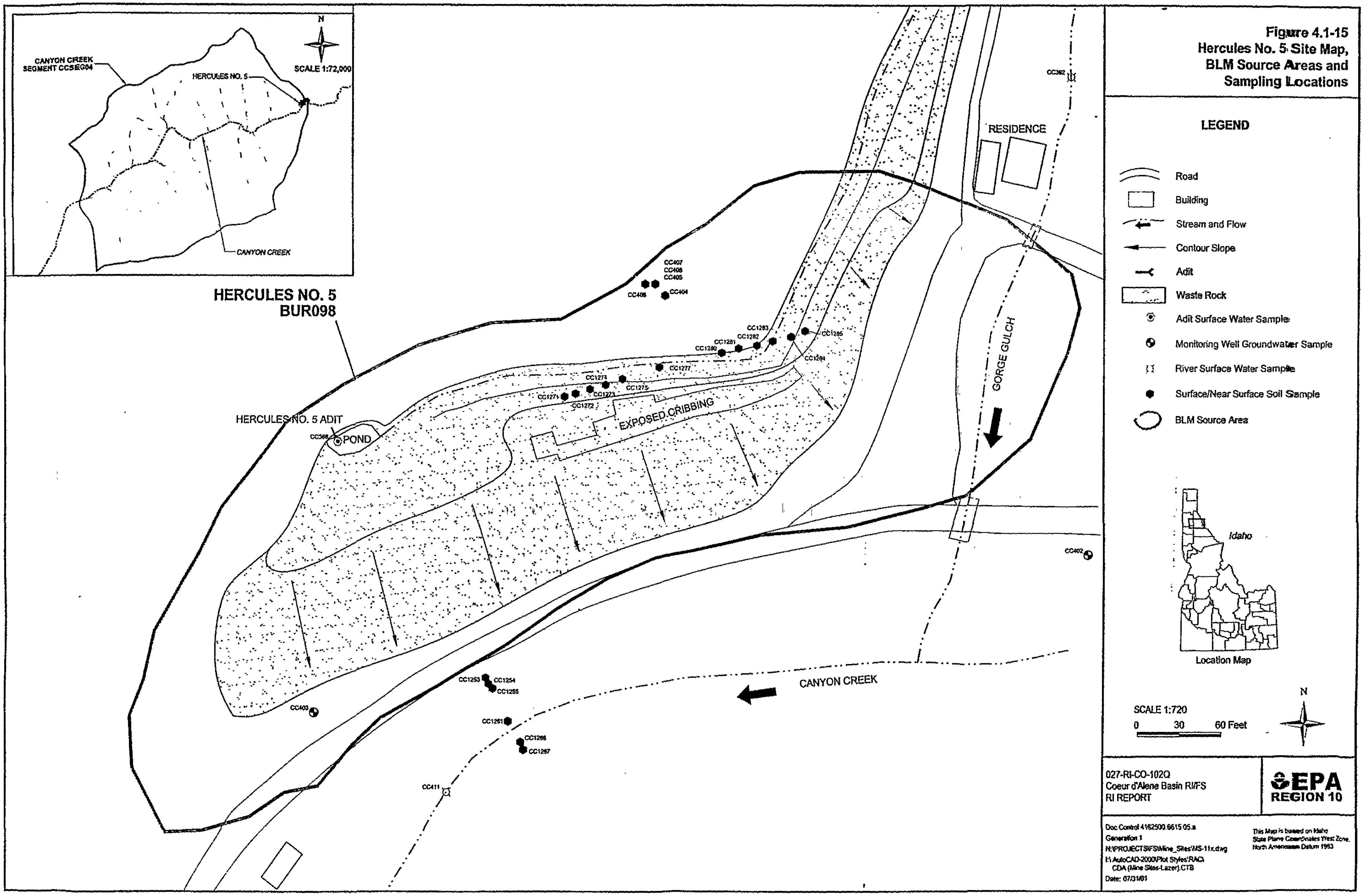

Figure 4.1-15
Hercules No. 5 Site Map, BLM Source Areas and Sampling Locations

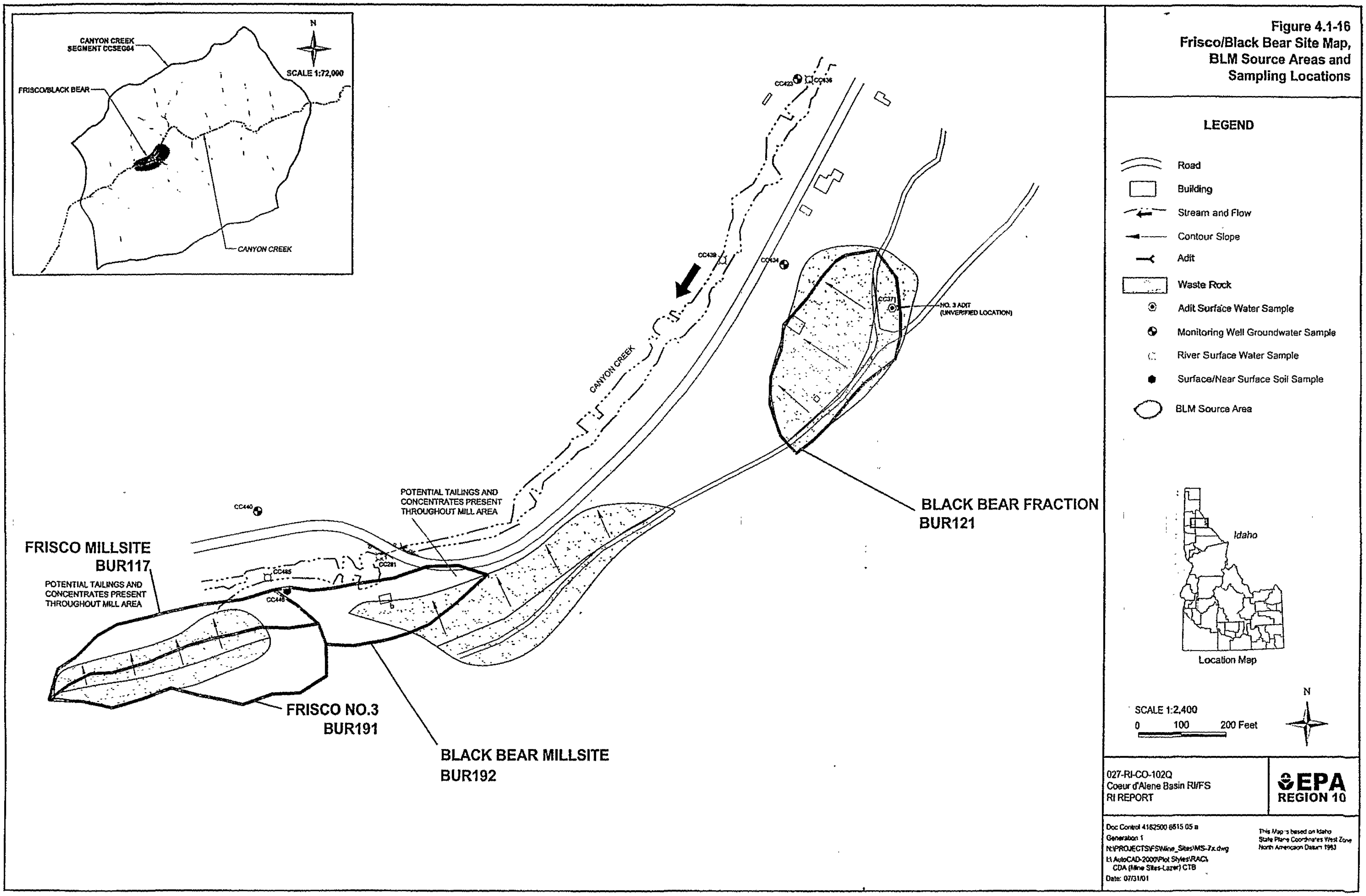

Figure 4.1-16
Frisco/Black Bear Site Map, BLM Source Areas and Sampling Locations

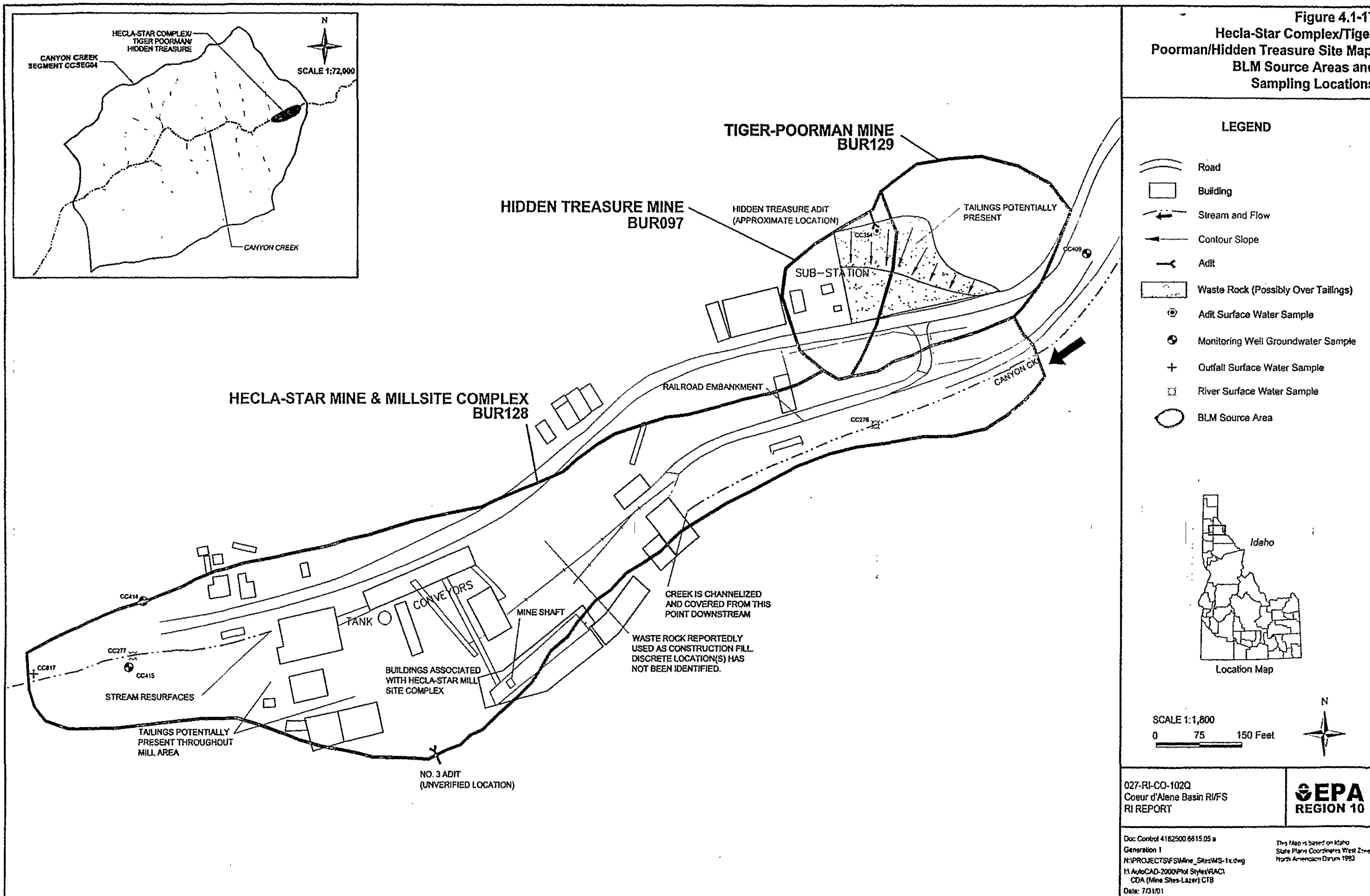

Figure 4.1-17
Hecla-Star Complex/Tiger Poorman/Hidden Treasure Site Map, BLM Source Areas and Sampling Locations

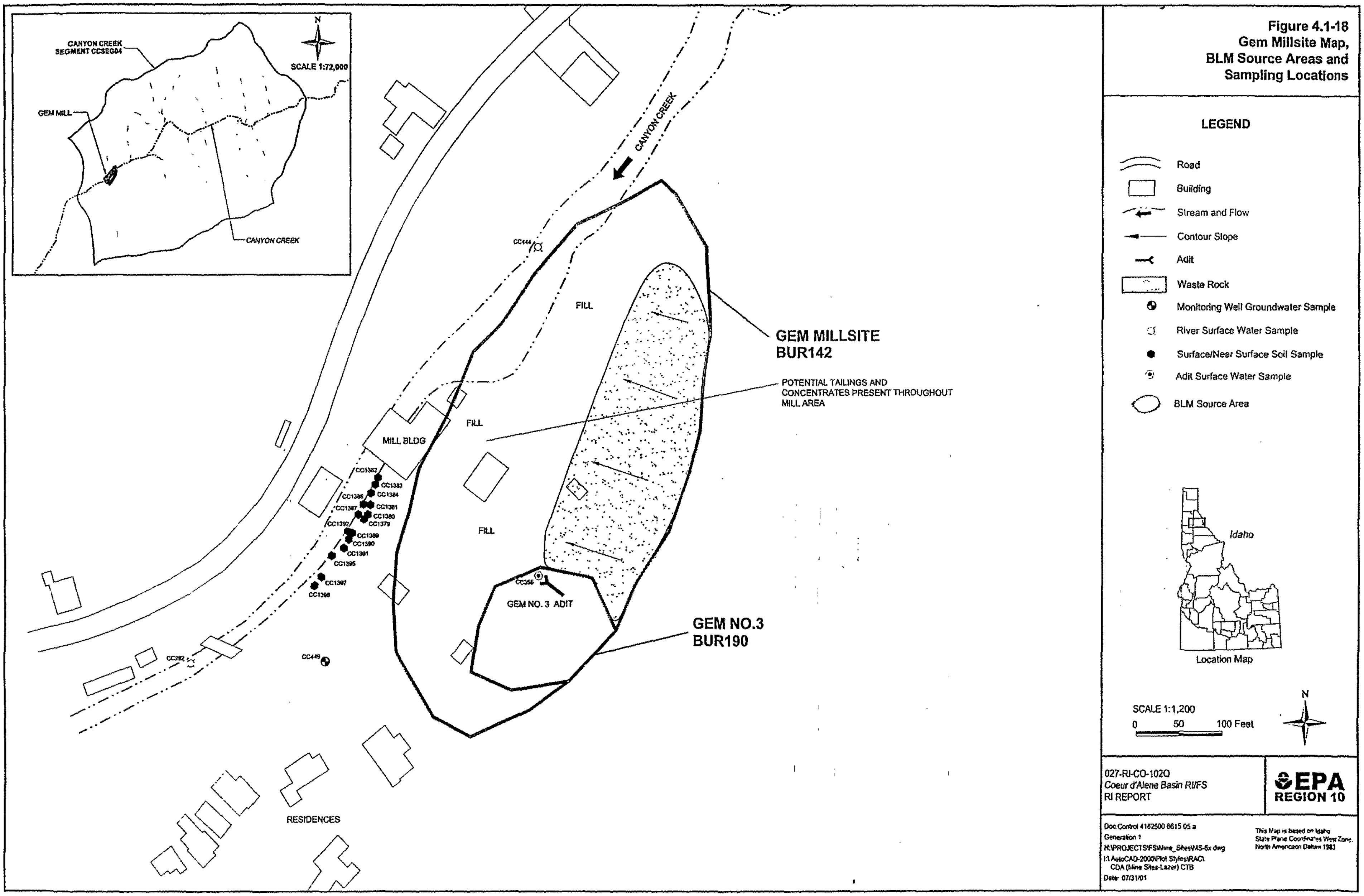

Figure 4.1-18
Gem Millsite Map, BLM Source Areas and Sampling Locations

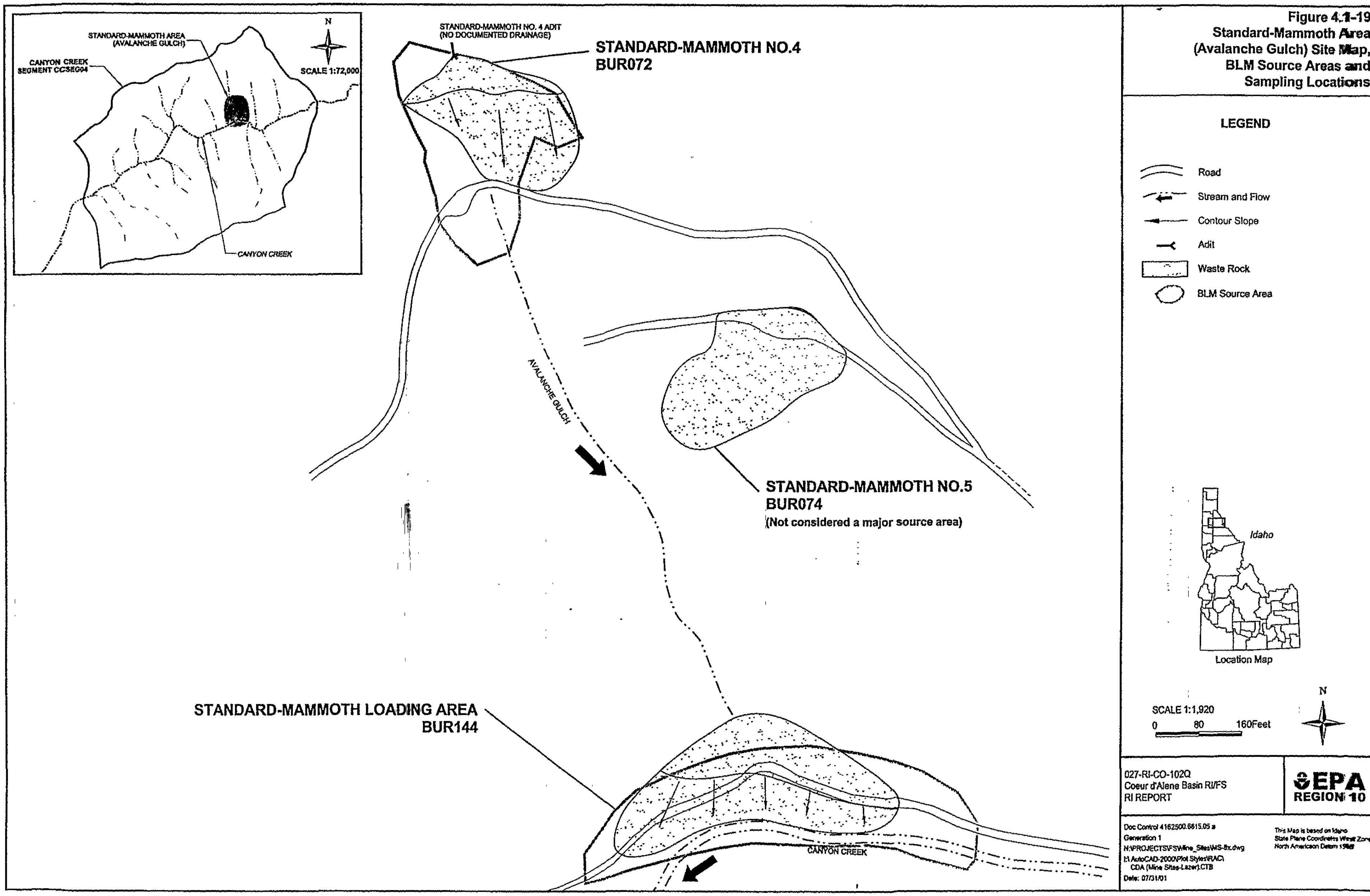

Figure 4.1-19
Standard-Mammoth Area (Avalanche Gulch) Site Map, BLM Source Areas and Sampling Locations

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

Doc Control 4162500.6615.05 a
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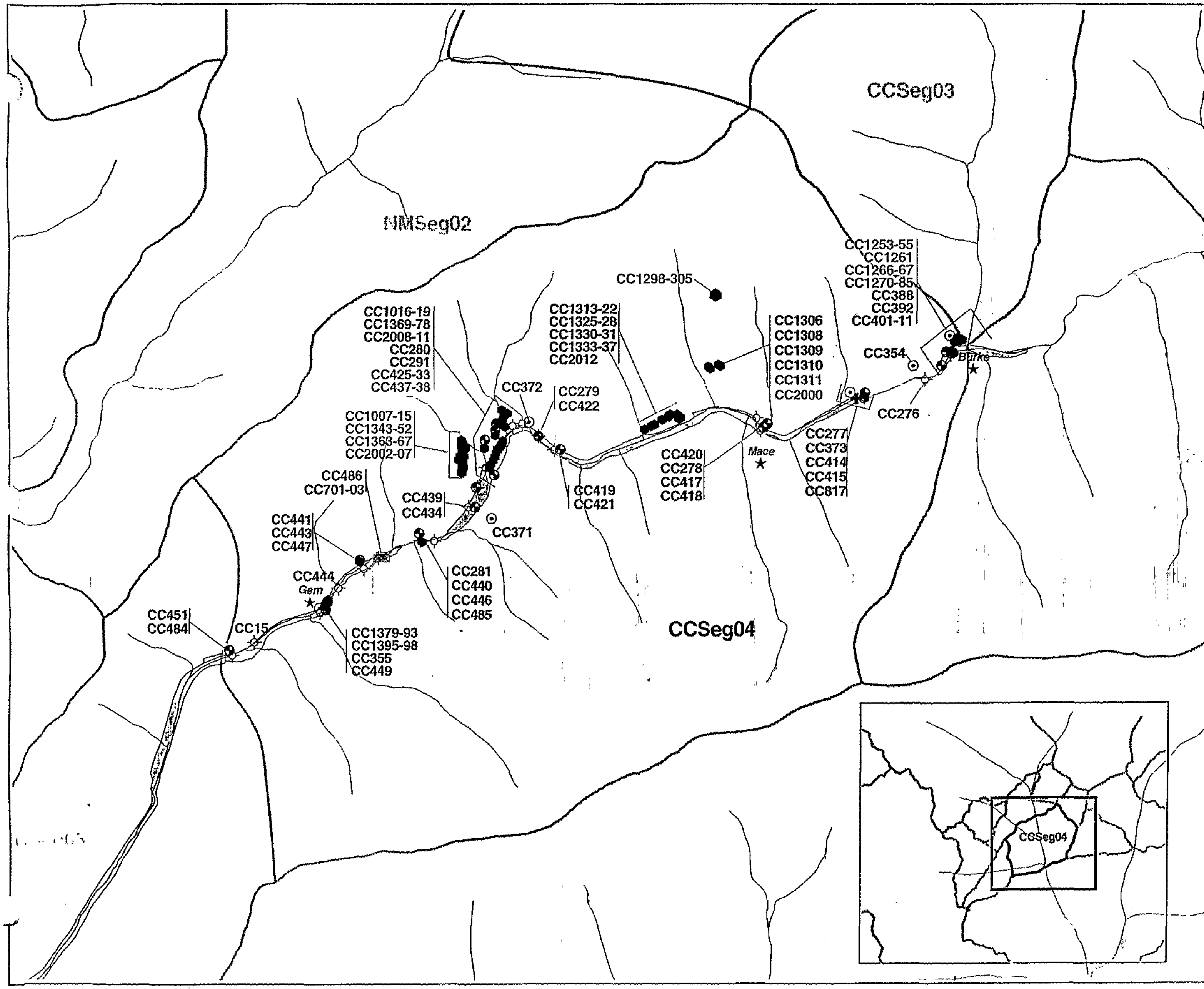
Date: 07/31/01

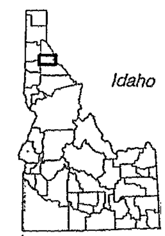
This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Figure 4.1-20
CCSeg04
Impacted Floodplain Reaches Site Map,
BLM Source Areas and Sampling Locations



LEGEND

- Adit Sampling Location
- Bore Hole Sampling Location
- Floodplain Sampling Location
- Ground Sampling Location
- Hand Auger Sampling Location
- Lake Sampling Location
- Outfall Sampling Location
- River Sampling Location
- Seep Sampling Location
- Tailings Sampling Location
- Test Pit Sampling Location
- City
- Stream
- River
- River Segment Boundary
- BLM Source Area
- Floodplain



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:24,000

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027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA
REGION 10

Document Control 4162500 6615 05 a
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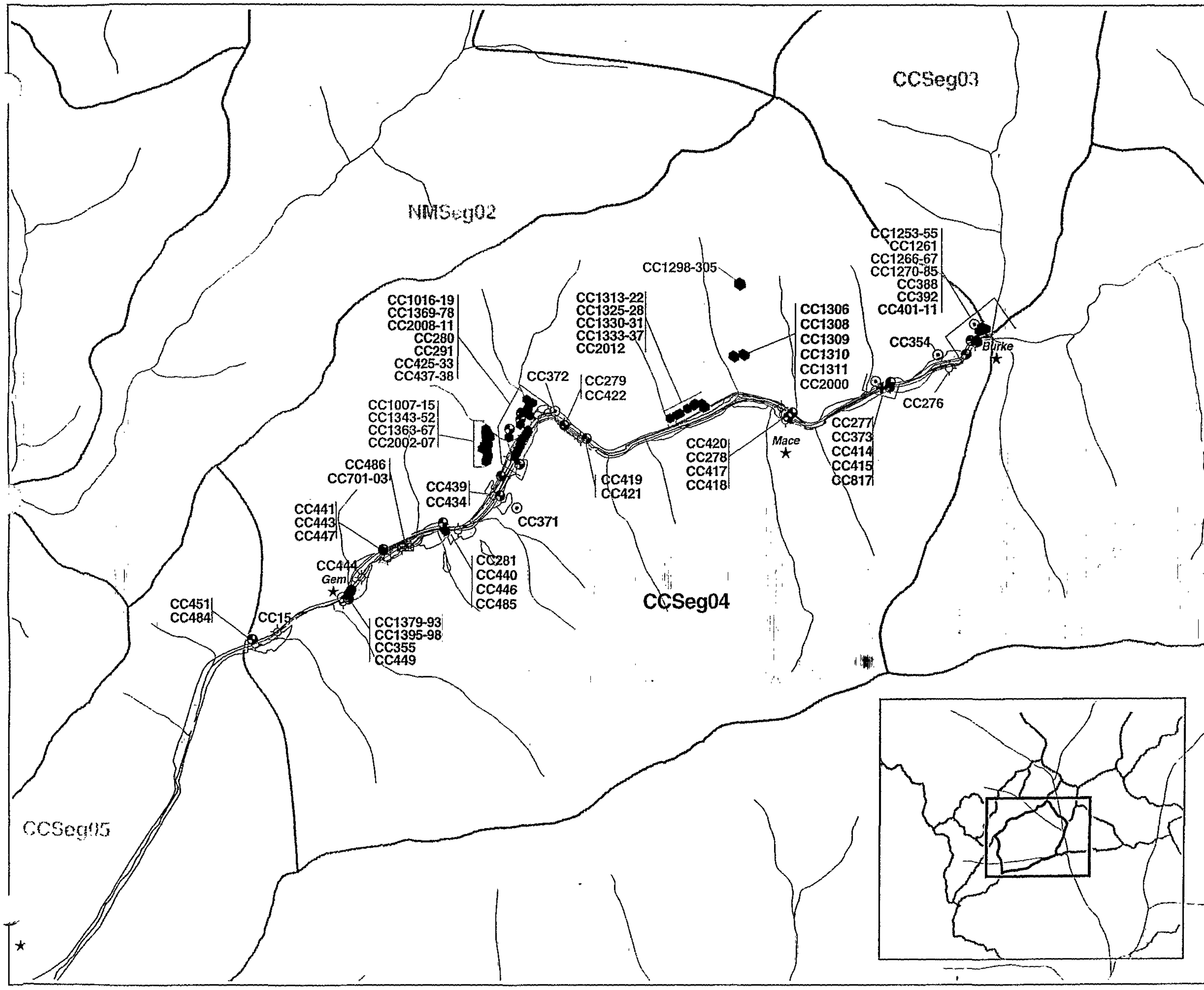
E: CC4 BLM
L: Final RI CCseg04 BLM
7/31/2001

This Map is based on Idaho
State Plane Coordinates West Zone
North American Datum 1983

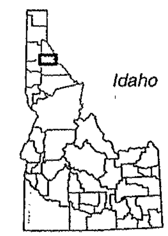
Date of Plot July 31, 2001

Figure 4.1-21
CCSeg04
Impacted Floodplain Reaches Site Map, Geologic Units and Sampling Locations



LEGEND

- Adit Sampling Location
- Bore Hole Sampling Location
- Floodplain Sampling Location
- Ground Sampling Location
- Hand Auger Sampling Location
- Lake Sampling Location
- Outfall Sampling Location
- River Sampling Location
- Seep Sampling Location
- Tailings Sampling Location
- Test Pit Sampling Location
- City
- Stream
- River
- River Segment Boundary
- Geologic Units *
- Floodplain



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

*Box,S.E., A.A. Bookstrom, and W.N Kelly. 1999. Surficial geology of the valley of the South Fork of the Coeur d'Alene River, Idaho. U.S. Geological Survey Open File Report 99-XXX. Draft version, October 1999; and ArcView GIS Coverage, January 2000.

SCALE 1:26,000

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027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA
REGION 10

Document Control 4162500 6815 05a
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V: CCSeg4 GU
E: CCSeg4 GU
L: Final RI CCSeg4 GU
7/31/2001

This Map is based on Idaho State Plane Coordinates West Zone North American Datum 1983

Date of Plot July 31, 2001

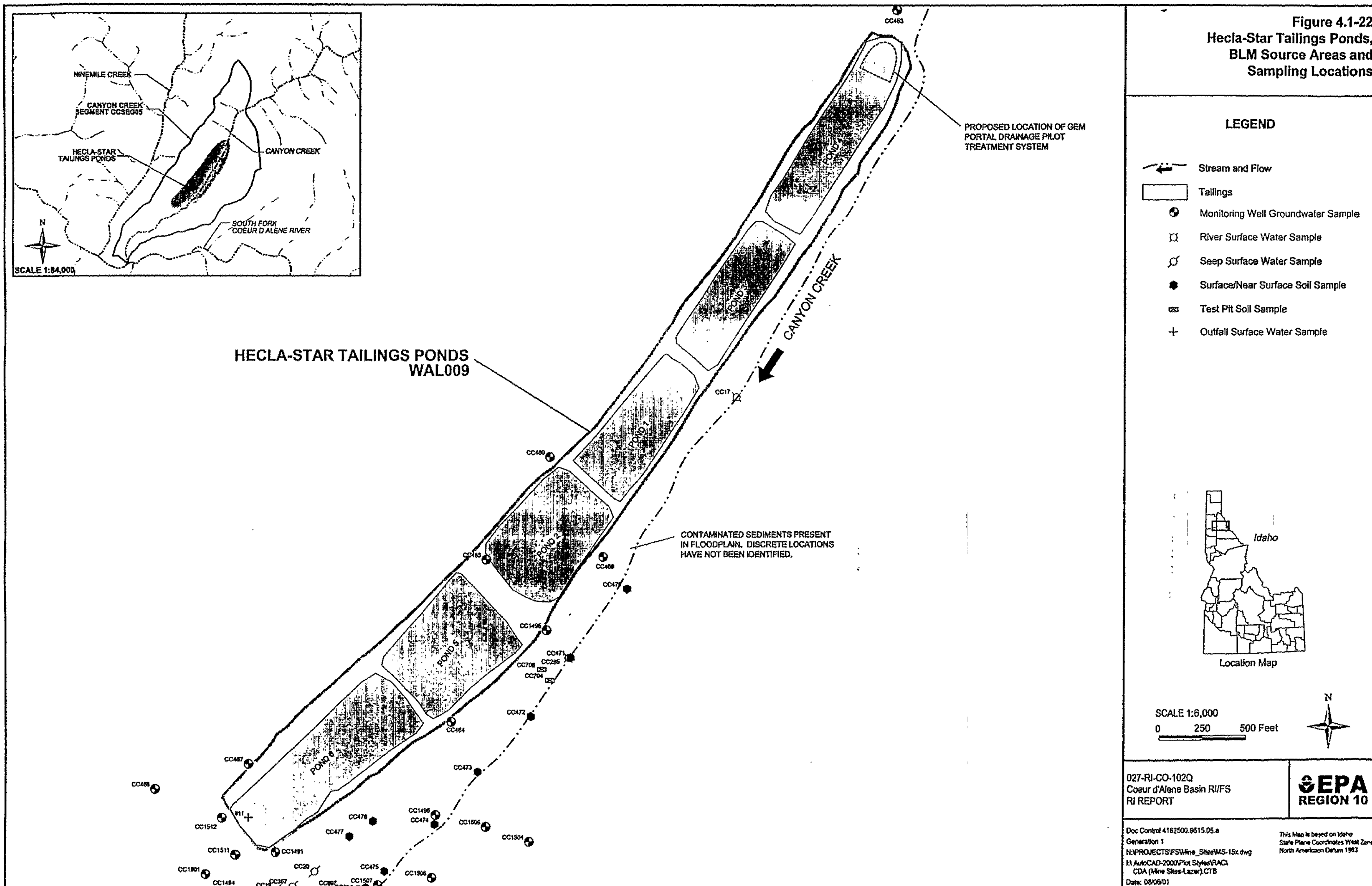

Figure 4.1-22
Hecla-Star Tailings Ponds, BLM Source Areas and Sampling Locations

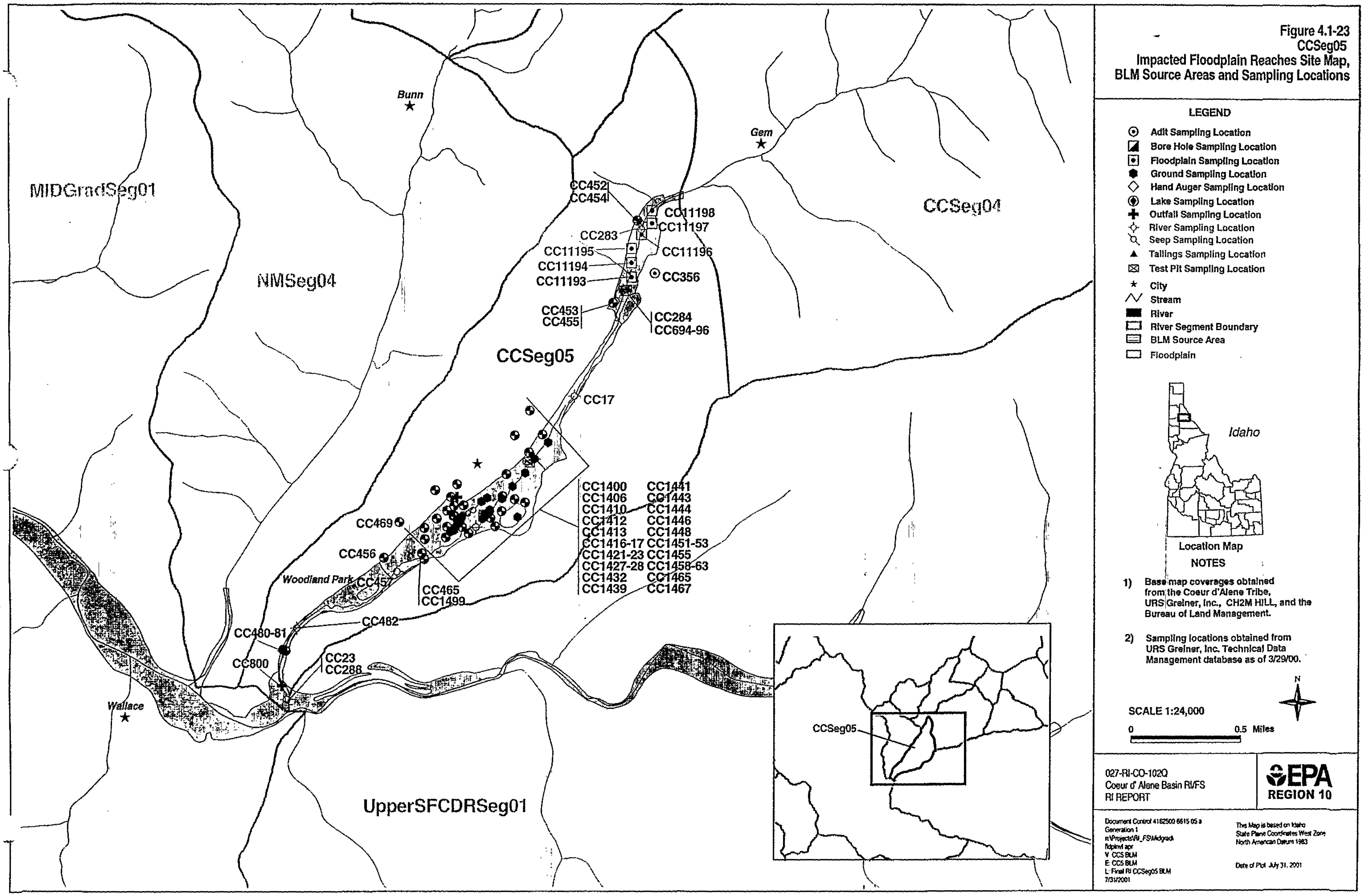

Figure 4.1-23
CCSeg05
Impacted Floodplain Reaches Site Map,
BLM Source Areas and Sampling Locations
LEGEND
Adit Sampling Location
Bore Hole Sampling Location
Floodplain Sampling Location
Ground Sampling Location
Hand Auger Sampling Location
Lake Sampling Location
Outfall Sampling Location
River Sampling Location
Seep Sampling Location
Tailings Sampling Location
Test Pit Sampling Location
City
Stream
River
River Segment Boundary
BLM Source Area
Floodplain
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.
2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.
N
SCALE 1:24,000
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027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT
EPA
REGION 10
Document Control 4162500 6615 05 a
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E: CC5 BLM
L: Final RI CCSeg05 BLM
7/31/2001
This Map is based on Idaho
State Plane Coordinates West Zone
North American Datum 1983
Date of Plot July 31, 2001
Bunn
Gem
MIDGradSeg01
NMSeg04
CCSeg04
CCSeg05
UpperSFCDRSeg01
Wallace
Woodland Park
CC452
CC454
CC11198
CC11197
CC283
CC11195
CC11196
CC11194
CC11193
CC356
CC453
CC455
CC284
CC694-96
CC17
CC1400
CC1406
CC1410
CC1412
CC1413
CC1416-17
CC1421-23
CC1427-28
CC1432
CC1439
CC1441
CC1443
CC1444
CC1446
CC1448
CC1451-53
CC1455
CC1458-63
CC1465
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CC800
CC23
CC288
CCSeg05

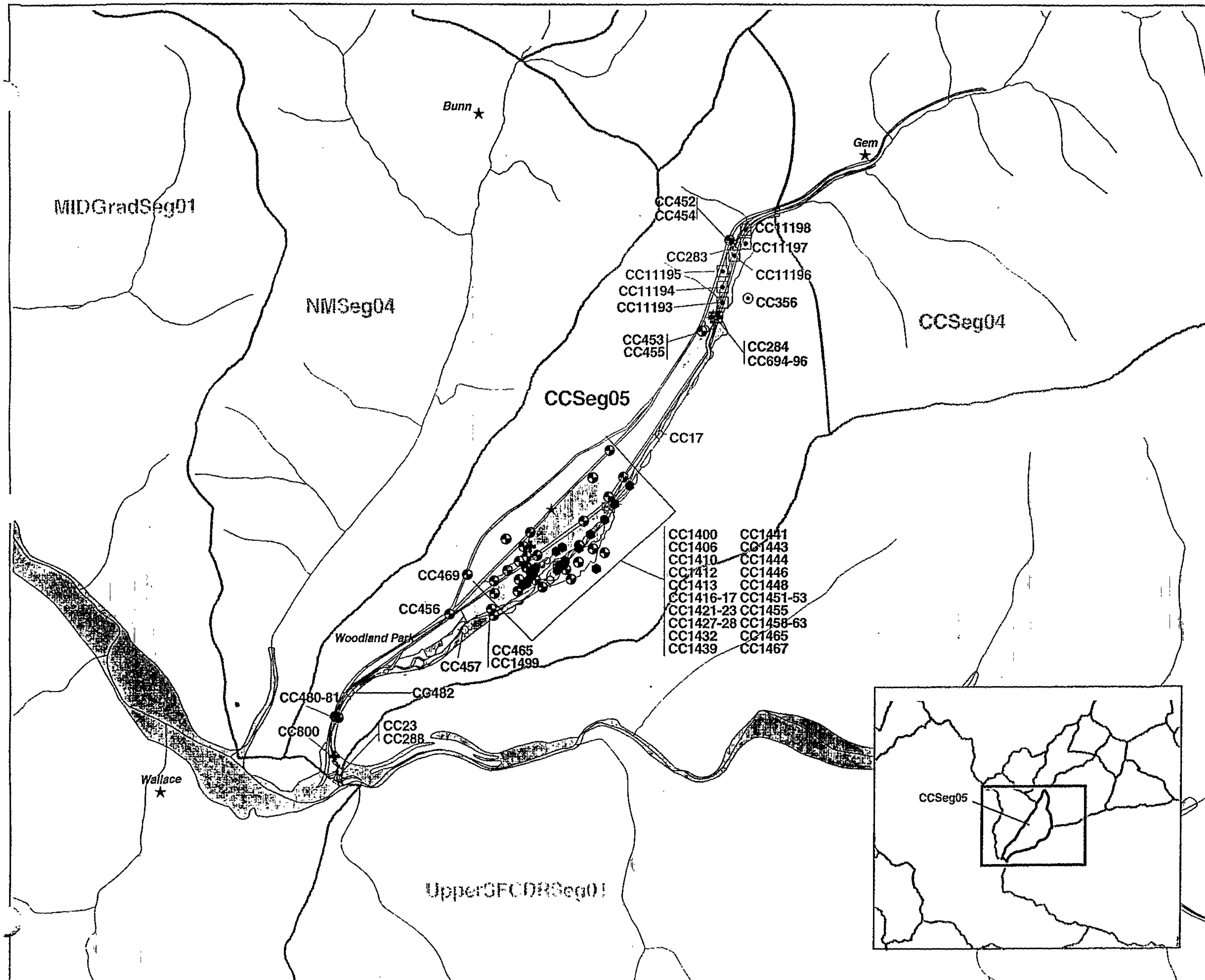
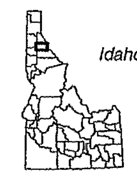


Figure 4.1-24
CCSeg05
Impacted Floodplain Reaches Site Map, Geologic Units and Sampling Locations

LEGEND

- Adit Sampling Location
- Bore Hole Sampling Location
- Floodplain Sampling Location
- Ground Sampling Location
- Hand Auger Sampling Location
- Lake Sampling Location
- Outfall Sampling Location
- River Sampling Location
- Seep Sampling Location
- Tailings Sampling Location
- Test Pit Sampling Location
- City
- Stream
- River
- River Segment Boundary
- Geologic Units *
- Floodplain



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

*Box, S.E., A.A. Bookstrom, and W.N Kelly. 1999. Surficial geology of the valley of the South Fork of the Coeur d'Alene River, Idaho. U.S. Geological Survey Open File Report 99-XXX. Draft version, October 1999; and ArcView GIS Coverage, January 2000.

SCALE 1:24,000
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027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA
REGION 10

Doc Control 4162500.6615 05 a
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\fdplnM apr
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E: CC5 USGS
L: CC5 USGS
08/04/01

This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot August 4 2001

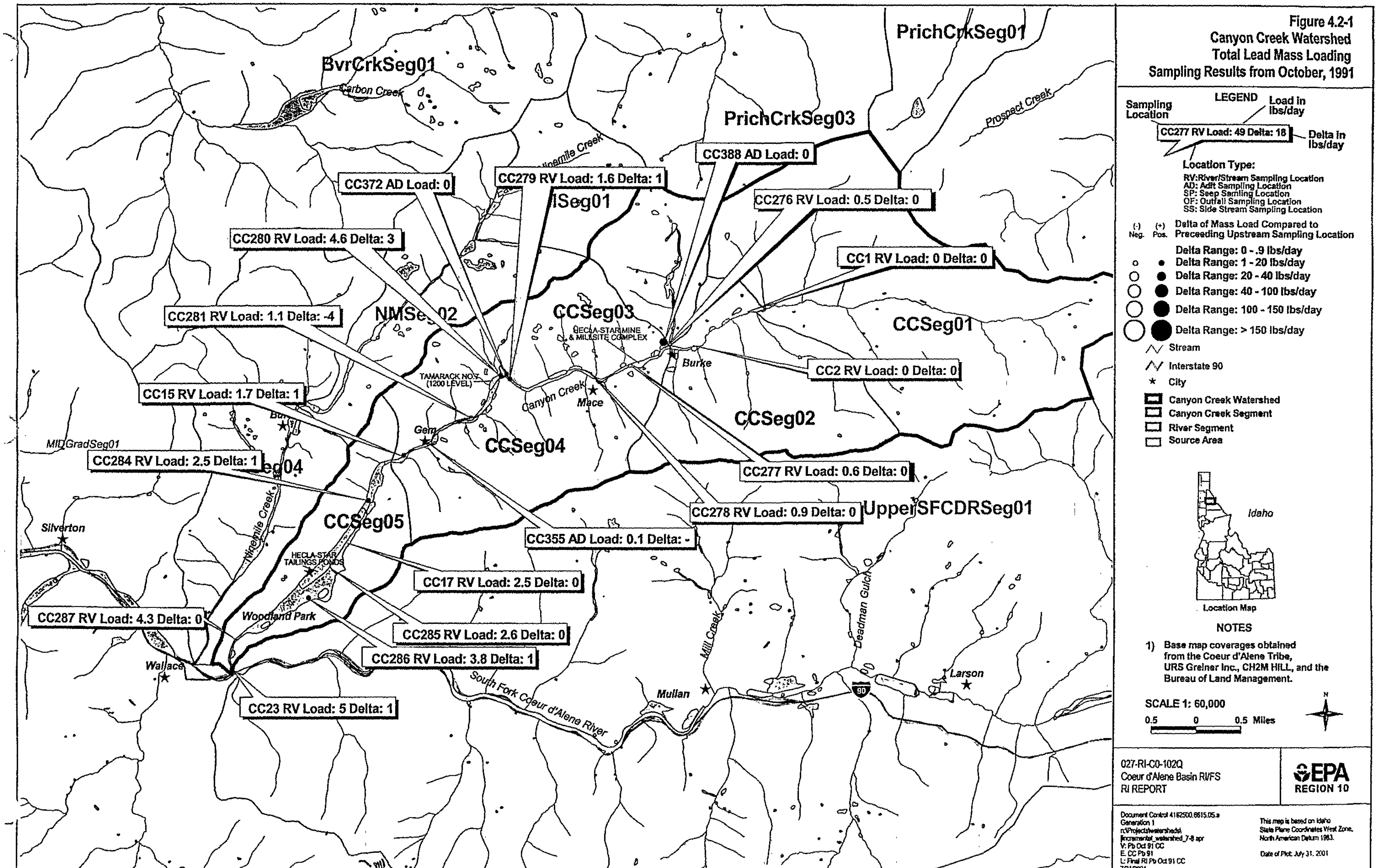

Figure 4.2-1
Canyon Creek Watershed
Total Lead Mass Loading
Sampling Results from October, 1991

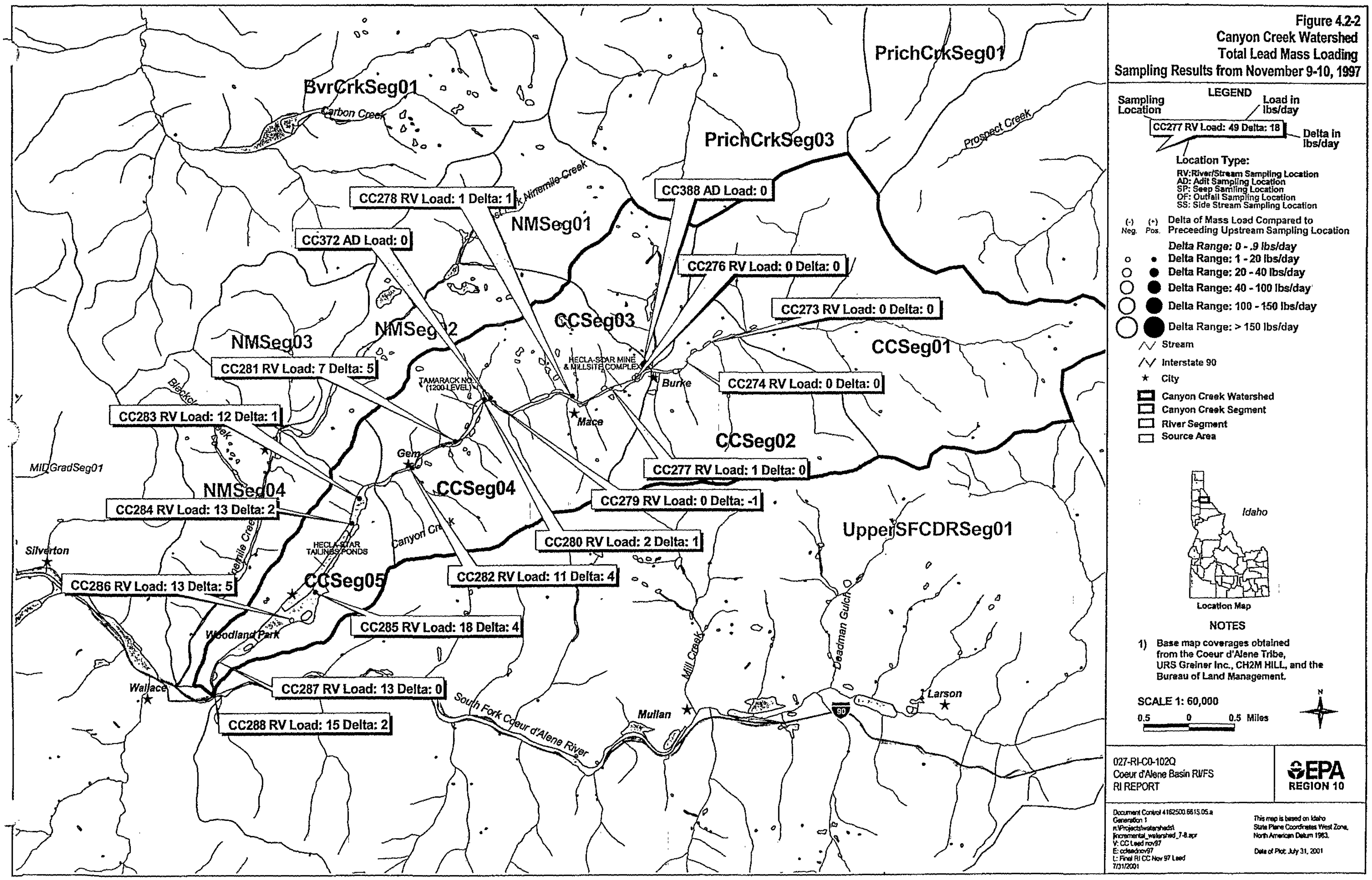

Figure 4.2-2
Canyon Creek Watershed
Total Lead Mass Loading
Sampling Results from November 9-10, 1997
LEGEND
Sampling Location
Load in lbs/day
CC277 RV Load: 49 Delta: 18
Delta in lbs/day
Location Type:
RV: River/Stream Sampling Location
AD: Adit Sampling Location
SP: Seep Samling Location
OF: Outfall Sampling Location
SS: Side Stream Sampling Location
(-) Neg. (+) Pos. Delta of Mass Load Compared to Preceeding Upstream Sampling Location
Delta Range: 0 - .9 lbs/day
Delta Range: 1 - 20 lbs/day
Delta Range: 20 - 40 lbs/day
Delta Range: 40 - 100 lbs/day
Delta Range: 100 - 150 lbs/day
Delta Range: > 150 lbs/day
Stream
Interstate 90
City
Canyon Creek Watershed
Canyon Creek Segment
River Segment
Source Area
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.
SCALE 1: 60,000
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N
027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
Document Control 4162500.6815.05.a
Generation 1
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E: ccleadnov97
L: Final RI CC Nov 97 Lead
7/31/2001
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.
Date of Plot: July 31, 2001
BvrCrkSeg01
Carbon Creek
PrichCrkSeg01
PrichCrkSeg03
Prospect Creek
East Fork Ninemile Creek
NMSeg01
NMSeg02
NMSeg03
NMSeg04
CCSeg01
CCSeg02
CCSeg03
CCSeg04
CCSeg05
MIDGradSeg01
UpperSFCDRSeg01
CC278 RV Load: 1 Delta: 1
CC388 AD Load: 0
CC372 AD Load: 0
CC276 RV Load: 0 Delta: 0
CC273 RV Load: 0 Delta: 0
CC281 RV Load: 7 Delta: 5
CC274 RV Load: 0 Delta: 0
CC283 RV Load: 12 Delta: 1
CC277 RV Load: 1 Delta: 0
CC279 RV Load: 0 Delta: -1
CC284 RV Load: 13 Delta: 2
CC280 RV Load: 2 Delta: 1
CC282 RV Load: 11 Delta: 4
CC286 RV Load: 13 Delta: 5
CC285 RV Load: 18 Delta: 4
CC287 RV Load: 13 Delta: 0
CC288 RV Load: 15 Delta: 2
HECLA-STAR MINE & MILLSITE COMPLEX
TAMARACK NO. 7 (1200 LEVEL)
HECLA-STAR TAILINGS PONDS
Blackcloud Creek
Ninemile Creek
Canyon Creek
Mill Creek
Deadman Gulch
South Fork Coeur d'Alene River
Burke
Mace
Gem
Silverton
Woodland Park
Wallace
Mullan
Larson
90

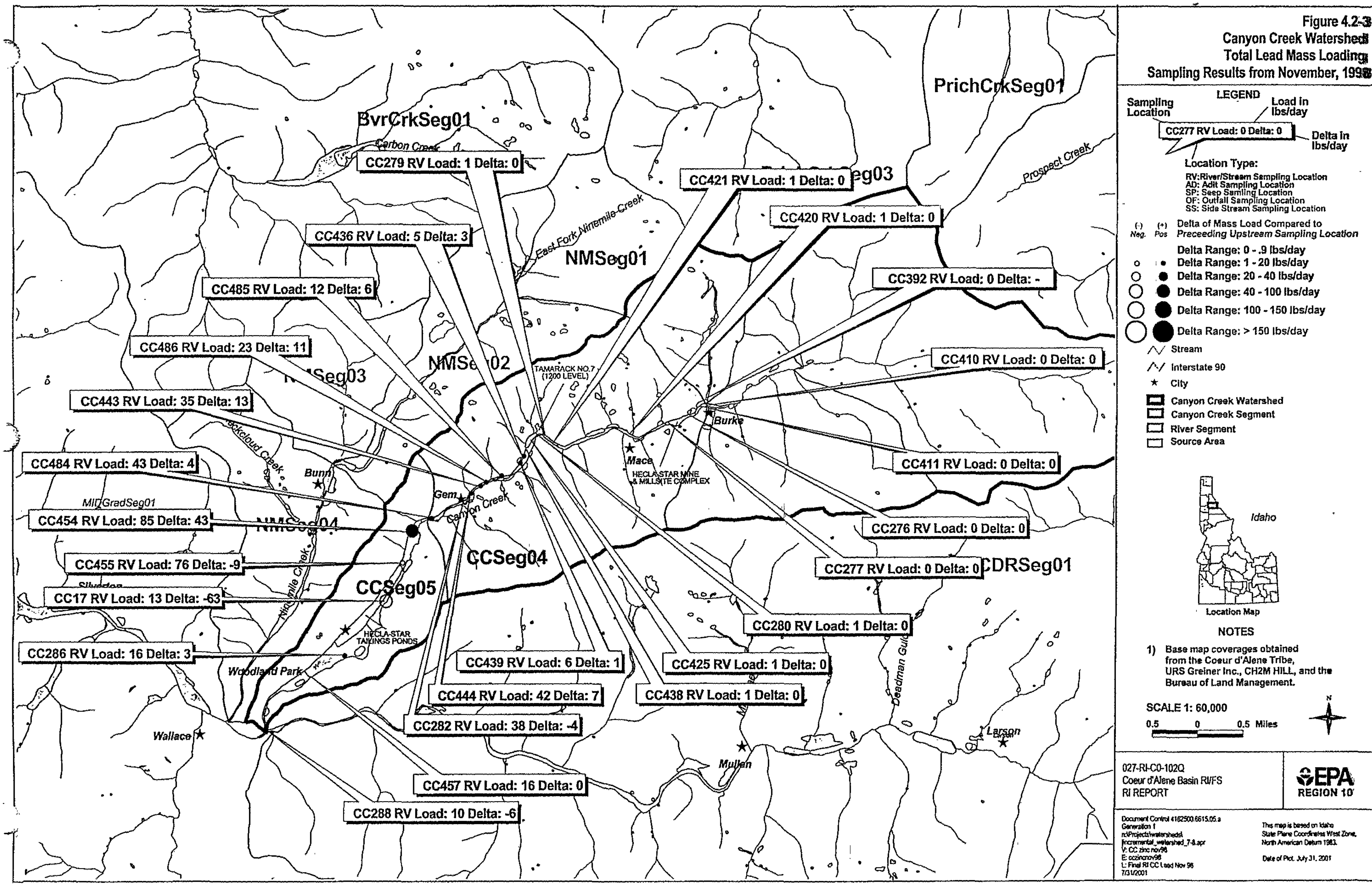

Figure 4.2-3
Canyon Creek Watershed
Total Lead Mass Loading
Sampling Results from November, 1998
LEGEND
Sampling Location
Load in lbs/day
CC277 RV Load: 0 Delta: 0
Delta in lbs/day
Location Type:
RV: River/Stream Sampling Location
AD: Adit Sampling Location
SP: Seep Samling Location
OF: Outfall Sampling Location
SS: Side Stream Sampling Location
(-) Neg. (+) Pos
Delta of Mass Load Compared to Preceeding Upstream Sampling Location
Delta Range: 0 - .9 lbs/day
Delta Range: 1 - 20 lbs/day
Delta Range: 20 - 40 lbs/day
Delta Range: 40 - 100 lbs/day
Delta Range: 100 - 150 lbs/day
Delta Range: > 150 lbs/day
Stream
Interstate 90
City
Canyon Creek Watershed
Canyon Creek Segment
River Segment
Source Area
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.
SCALE 1: 60,000
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027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.
Date of Plot: July 31, 2001
PrichCrkSeg01
BvrCrkSeg01
Carbon Creek
Prospect Creek
East Fork Ninemile Creek
NMSeg01
NMSeg02
NMSeg03
NMSeg04
CCSeg04
CCSeg05
CDRSeg01
MIDGradSeg01
TAMARACK NO.7 (1200 LEVEL)
Burke
Mace
HECLA STAR MINE & MILLSITE COMPLEX
HECLA-STAR TAILINGS PONDS
Gem
Canyon Creek
Blackcloud Creek
Burn
Ninemile Creek
Woodland Park
Wallace
Mullan
Larson
Deadman Gulch
CC279 RV Load: 1 Delta: 0
CC421 RV Load: 1 Delta: 0
CC420 RV Load: 1 Delta: 0
CC436 RV Load: 5 Delta: 3
CC485 RV Load: 12 Delta: 6
CC392 RV Load: 0 Delta: -
CC486 RV Load: 23 Delta: 11
CC410 RV Load: 0 Delta: 0
CC443 RV Load: 35 Delta: 13
CC484 RV Load: 43 Delta: 4
CC411 RV Load: 0 Delta: 0
CC454 RV Load: 85 Delta: 43
CC276 RV Load: 0 Delta: 0
CC455 RV Load: 76 Delta: -9
CC277 RV Load: 0 Delta: 0
CC17 RV Load: 13 Delta: -63
CC280 RV Load: 1 Delta: 0
CC286 RV Load: 16 Delta: 3
CC439 RV Load: 6 Delta: 1
CC425 RV Load: 1 Delta: 0
CC444 RV Load: 42 Delta: 7
CC438 RV Load: 1 Delta: 0
CC282 RV Load: 38 Delta: -4
CC457 RV Load: 16 Delta: 0
CC288 RV Load: 10 Delta: -6

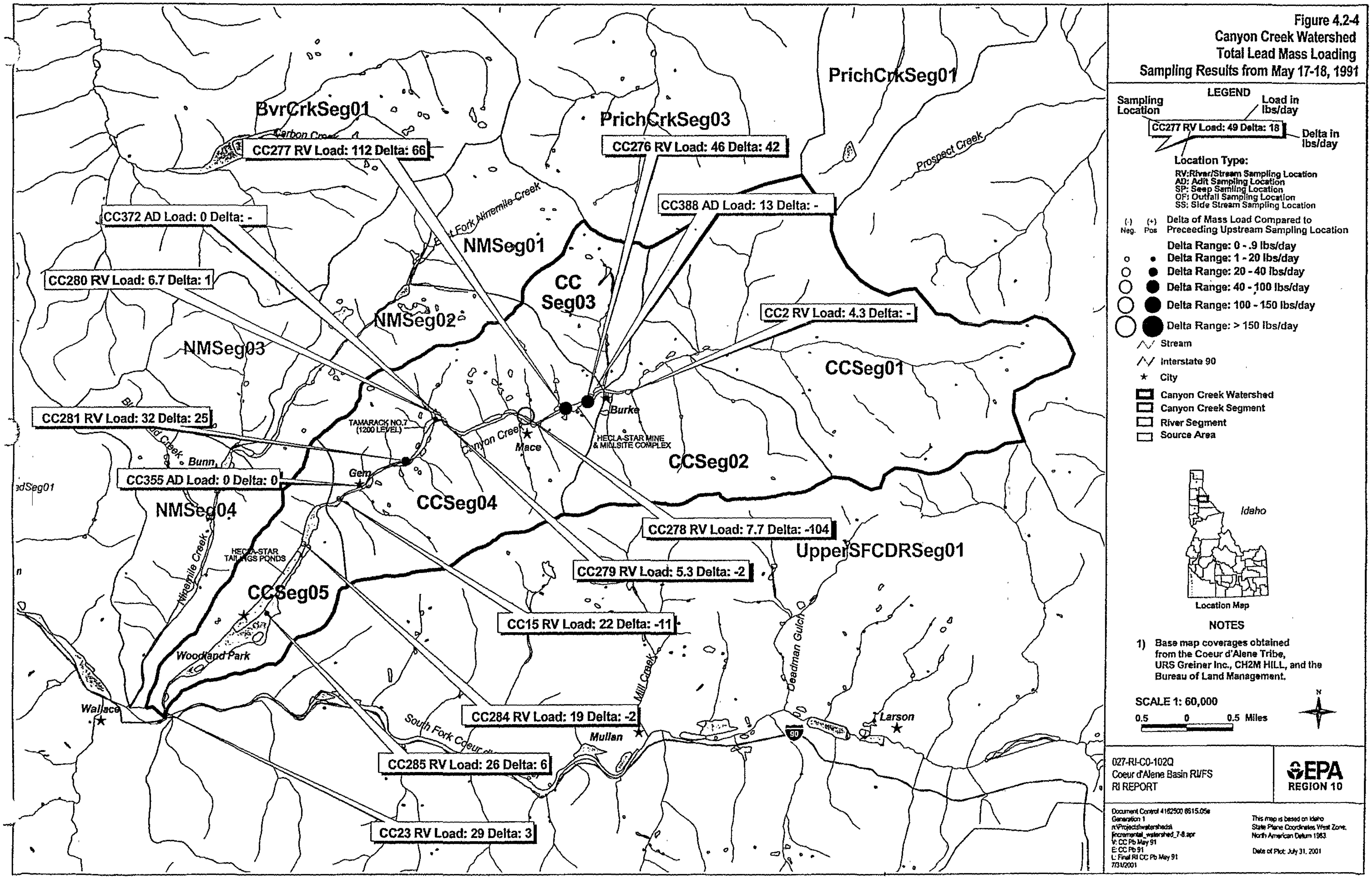
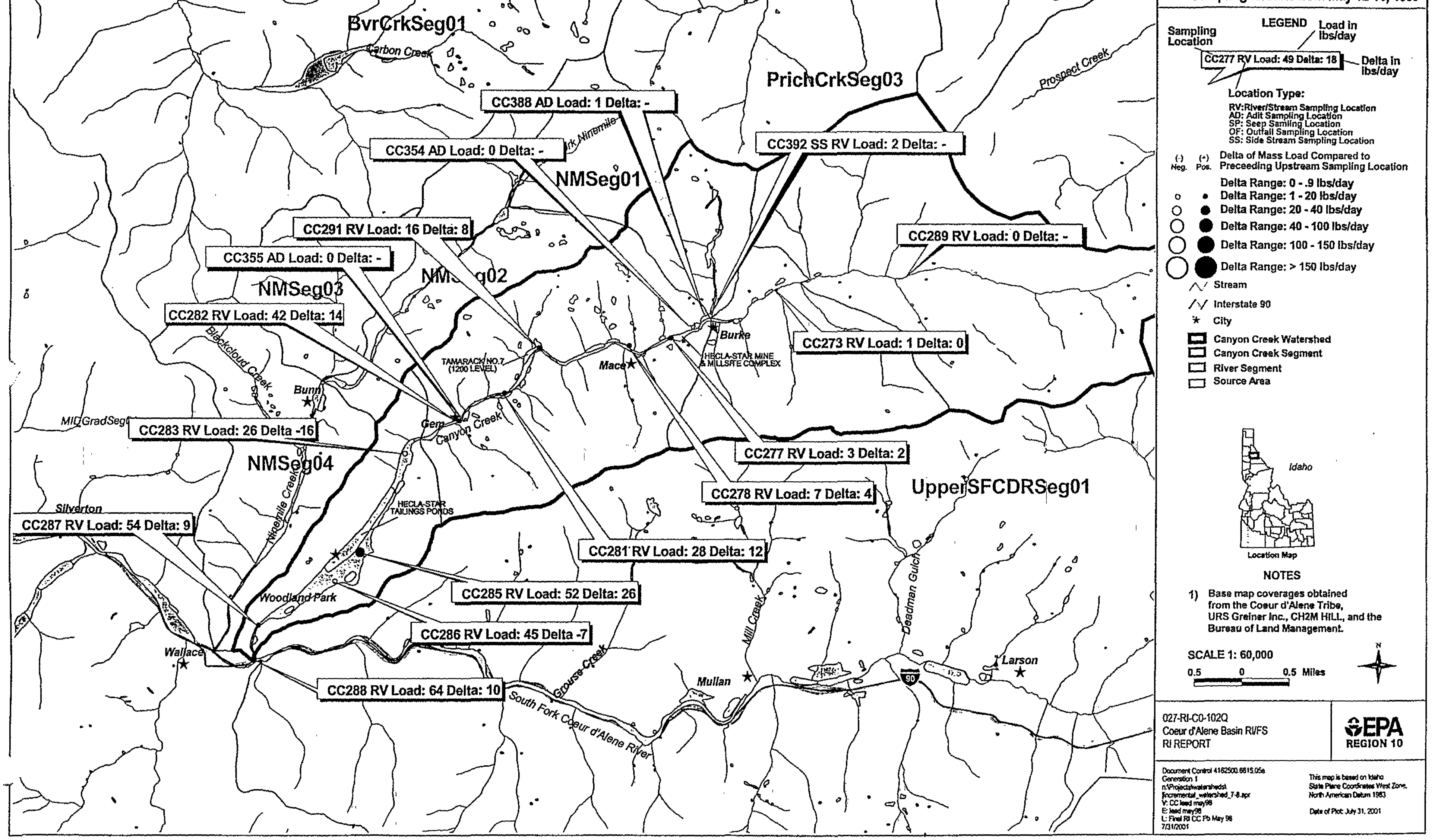


Figure 4.2-4
Canyon Creek Watershed
Total Lead Mass Loading
Sampling Results from May 17-18, 1991
LEGEND
Sampling Location
Load in lbs/day
CC277 RV Load: 49 Delta: 18
Delta in lbs/day
Location Type:
RV:River/Stream Sampling Location
AD: Adit Sampling Location
SP: Seep Samling Location
OF: Outfall Sampling Location
SS: Side Stream Sampling Location
(-) Neg.
(+) Pos
Delta of Mass Load Compared to Preceeding Upstream Sampling Location
Delta Range: 0 - .9 lbs/day
Delta Range: 1 - 20 lbs/day
Delta Range: 20 - 40 lbs/day
Delta Range: 40 - 100 lbs/day
Delta Range: 100 - 150 lbs/day
Delta Range: > 150 lbs/day
Stream
Interstate 90
City
Canyon Creek Watershed
Canyon Creek Segment
River Segment
Source Area
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.
SCALE 1: 60,000
0.5 0 0.5 Miles
027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983
Date of Plot: July 31, 2001
BvrCrkSeg01
PrichCrkSeg03
PrichCrkSeg01
CC277 RV Load: 112 Delta: 66
CC276 RV Load: 46 Delta: 42
CC372 AD Load: 0 Delta: -
CC388 AD Load: 13 Delta: -
CC280 RV Load: 6.7 Delta: 1
CC2 RV Load: 4.3 Delta: -
CC281 RV Load: 32 Delta: 25
CC355 AD Load: 0 Delta: 0
CC278 RV Load: 7.7 Delta: -104
CC279 RV Load: 5.3 Delta: -2
CC15 RV Load: 22 Delta: -11
CC284 RV Load: 19 Delta: -2
CC285 RV Load: 26 Delta: 6
CC23 RV Load: 29 Delta: 3
NMSeg01
NMSeg02
NMSeg03
NMSeg04
CC Seg03
CCSeg01
CCSeg02
CCSeg04
CCSeg05
UpperSFCDRSeg01
Prospect Creek
Carbon Creek
Canyon Creek
Ninemile Creek
Mill Creek
Deadman Gulch
South Fork Coeur d'Alene
Burke
Mace
Gem
Bunn
Woodland Park
Wallace
Mullan
Larson
TAMARACK NO.7 (1200 LEVEL)
HECLA-STAR MINE & MILLSITE COMPLEX
HECLA-STAR TAILINGS PONDS
90

Figure 4.2-5
Canyon Creek Watershed
Total Lead Mass Loading
Sampling Results from May 12-16, 1998



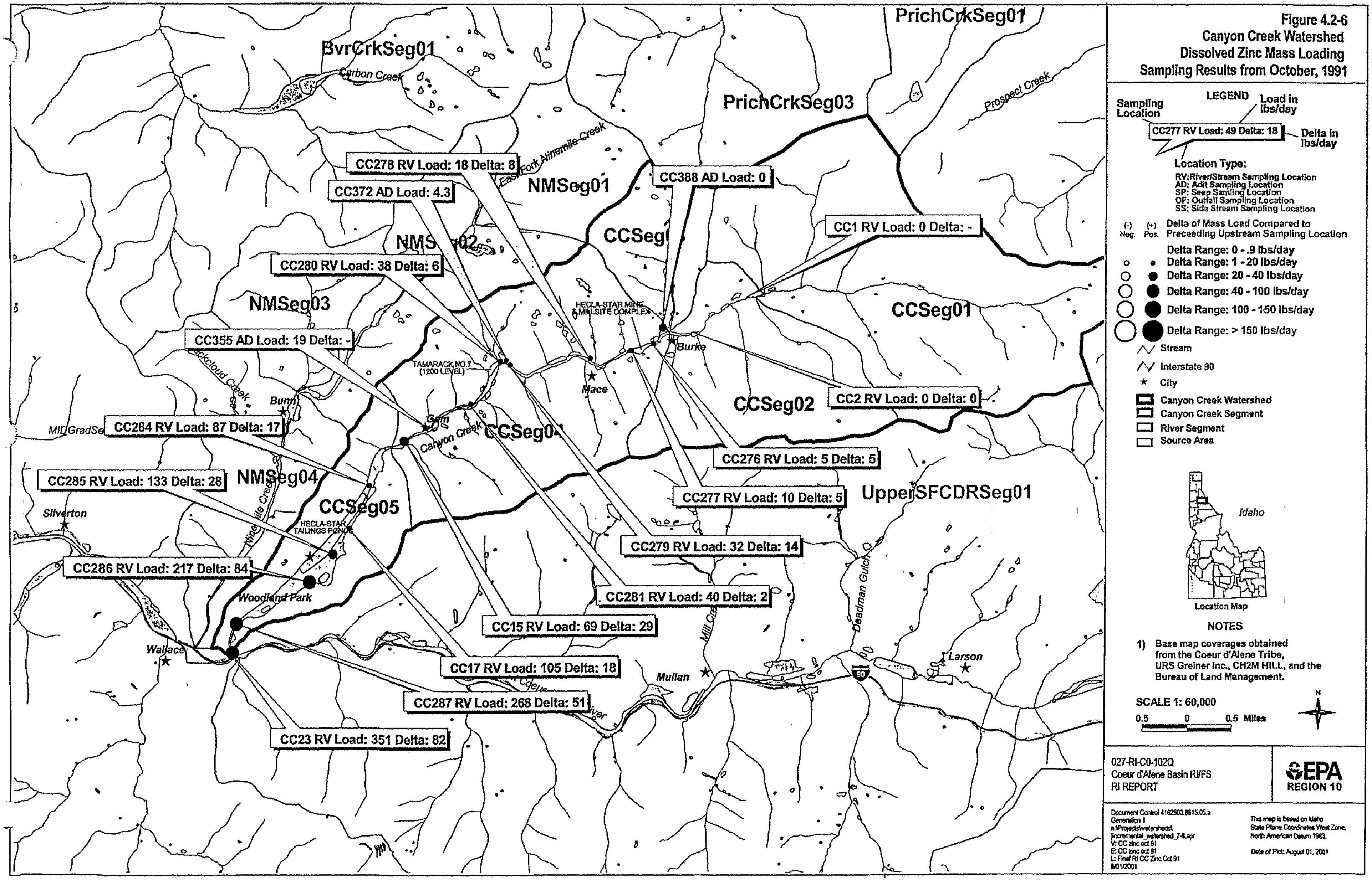


Figure 4.2-6
Canyon Creek Watershed
Dissolved Zinc Mass Loading
Sampling Results from October, 1991
LEGEND
Sampling Location
Load in lbs/day
CC277 RV Load: 49 Delta: 18
Delta in lbs/day
Location Type:
RV:River/Stream Sampling Location
AD: Adit Sampling Location
SP: Seep Samling Location
OF: Outfall Sampling Location
SS: Side Stream Sampling Location
(-) Neg. (+) Pos. Delta of Mass Load Compared to Preceeding Upstream Sampling Location
Delta Range: 0 - .9 lbs/day
Delta Range: 1 - 20 lbs/day
Delta Range: 20 - 40 lbs/day
Delta Range: 40 - 100 lbs/day
Delta Range: 100 - 150 lbs/day
Delta Range: > 150 lbs/day
Stream
Interstate 90
City
Canyon Creek Watershed
Canyon Creek Segment
River Segment
Source Area
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.
SCALE 1: 60,000
0.5 0 0.5 Miles
027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.
Date of Plot: August 01, 2001
PrichCrkSeg01
BvrCrkSeg01
Carbon Creek
PrichCrkSeg03
Prospect Creek
East Fork Ninemile Creek
NMSeg01
NMSeg02
NMSeg03
NMSeg04
CCSeg01
CCSeg02
CCSeg04
CCSeg05
UpperSFCDRSeg01
CC278 RV Load: 18 Delta: 8
CC372 AD Load: 4.3
CC388 AD Load: 0
CC1 RV Load: 0 Delta: -
CC280 RV Load: 38 Delta: 6
HECLA-STAR MINE & MILLSITE COMPLEX
CC355 AD Load: 19 Delta: -
TAMARACK NO.7 (1200 LEVEL)
Burke
Mace
CC2 RV Load: 0 Delta: 0
Blackcloud Creek
Burn
Gem
Canyon Creek
CC284 RV Load: 87 Delta: 17
CC276 RV Load: 5 Delta: 5
CC285 RV Load: 133 Delta: 28
CC277 RV Load: 10 Delta: 5
Silverton
HECLA-STAR TAILINGS POND
CC279 RV Load: 32 Delta: 14
CC286 RV Load: 217 Delta: 84
Woodland Park
CC281 RV Load: 40 Delta: 2
Deadman Gulch
Mill Creek
CC15 RV Load: 69 Delta: 29
Wallace
CC17 RV Load: 105 Delta: 18
Mullan
Larson
90
CC287 RV Load: 268 Delta: 51
CC23 RV Load: 351 Delta: 82

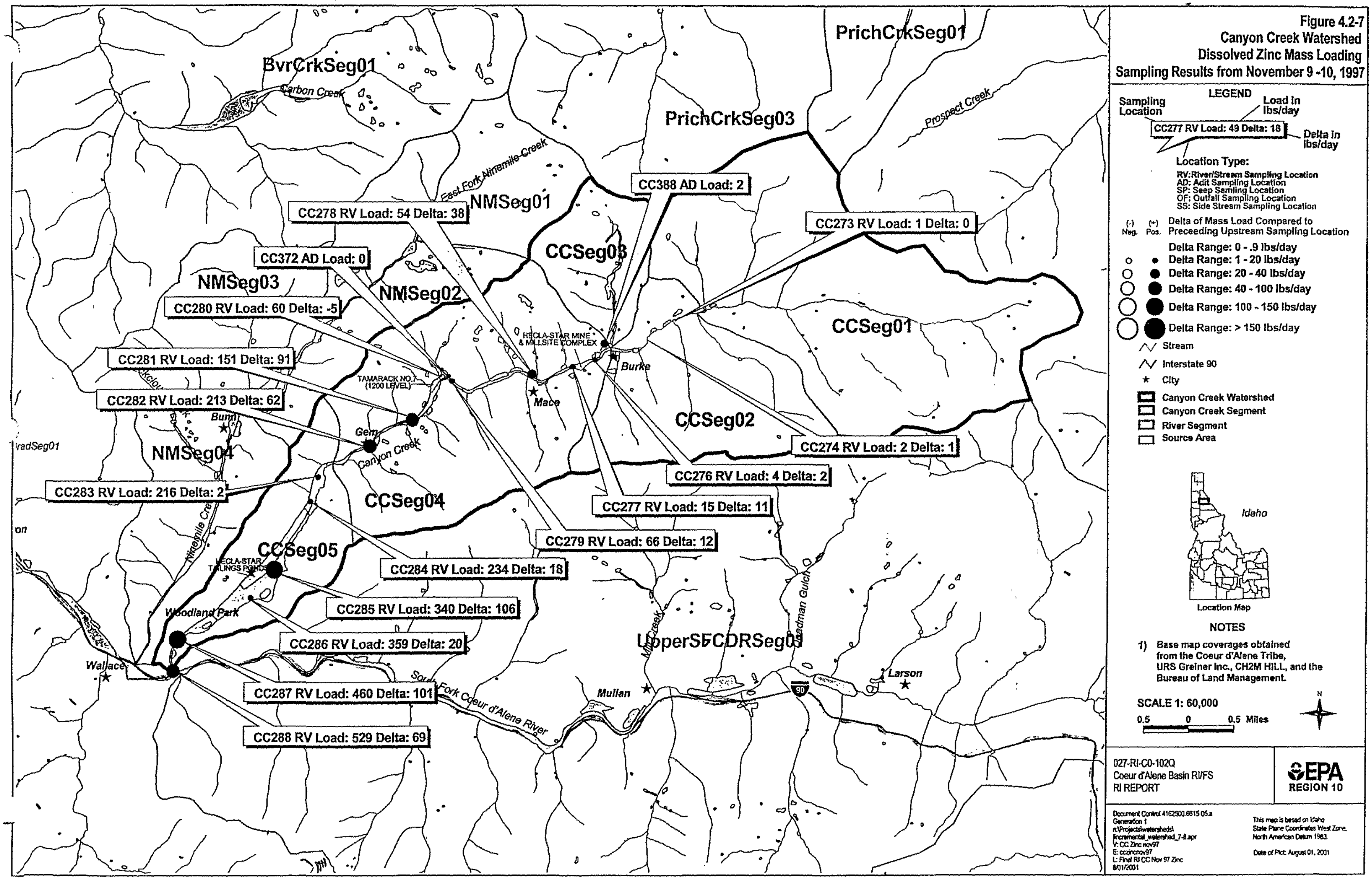


Figure 4.2-7
Canyon Creek Watershed
Dissolved Zinc Mass Loading
Sampling Results from November 9 -10, 1997
LEGEND
Sampling Location
Load in lbs/day
CC277 RV Load: 49 Delta: 18
Delta in lbs/day
Location Type:
RV: River/Stream Sampling Location
AD: Adit Sampling Location
SP: Seep Samling Location
OF: Outfall Sampling Location
SS: Side Stream Sampling Location
(-) Neg.
(+) Pos.
Delta of Mass Load Compared to Preceeding Upstream Sampling Location
Delta Range: 0 - .9 lbs/day
Delta Range: 1 - 20 lbs/day
Delta Range: 20 - 40 lbs/day
Delta Range: 40 - 100 lbs/day
Delta Range: 100 - 150 lbs/day
Delta Range: > 150 lbs/day
Stream
Interstate 90
City
Canyon Creek Watershed
Canyon Creek Segment
River Segment
Source Area
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.
SCALE 1: 60,000
0.5 0 0.5 Miles
N
027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
Document Control 4162500.6815.05.a
Generation 1
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.
Date of Plot: August 01, 2001
PrichCrkSeg01
BvrCrkSeg01
Carbon Creek
PrichCrkSeg03
Prospect Creek
East Fork Ninemile Creek
NMSeg01
CC388 AD Load: 2
CC278 RV Load: 54 Delta: 38
CC273 RV Load: 1 Delta: 0
CC372 AD Load: 0
CCSeg03
NMSeg03
NMSeg02
CC280 RV Load: 60 Delta: -5
HECLA-STAR MINE & MILLSITE COMPLEX
CCSeg01
CC281 RV Load: 151 Delta: 91
TAMARACK NO.7 (1200 LEVEL)
Burke
Mace
CC282 RV Load: 213 Delta: 62
Burn
CCSeg02
Gem
CC274 RV Load: 2 Delta: 1
Canyon Creek
NMSeg04
CC276 RV Load: 4 Delta: 2
CC283 RV Load: 216 Delta: 2
CCSeg04
CC277 RV Load: 15 Delta: 11
Ninemile Creek
CC279 RV Load: 66 Delta: 12
CCSeg05
HECLA-STAR TAILINGS PONDS
CC284 RV Load: 234 Delta: 18
CC285 RV Load: 340 Delta: 106
Woodland Park
Mill Creek
Gorman Gulch
UpperSFCDRSeg01
CC286 RV Load: 359 Delta: 20
Wallace
Larson
CC287 RV Load: 460 Delta: 101
South Fork Coeur d'Alene River
Mullan
90
CC288 RV Load: 529 Delta: 69

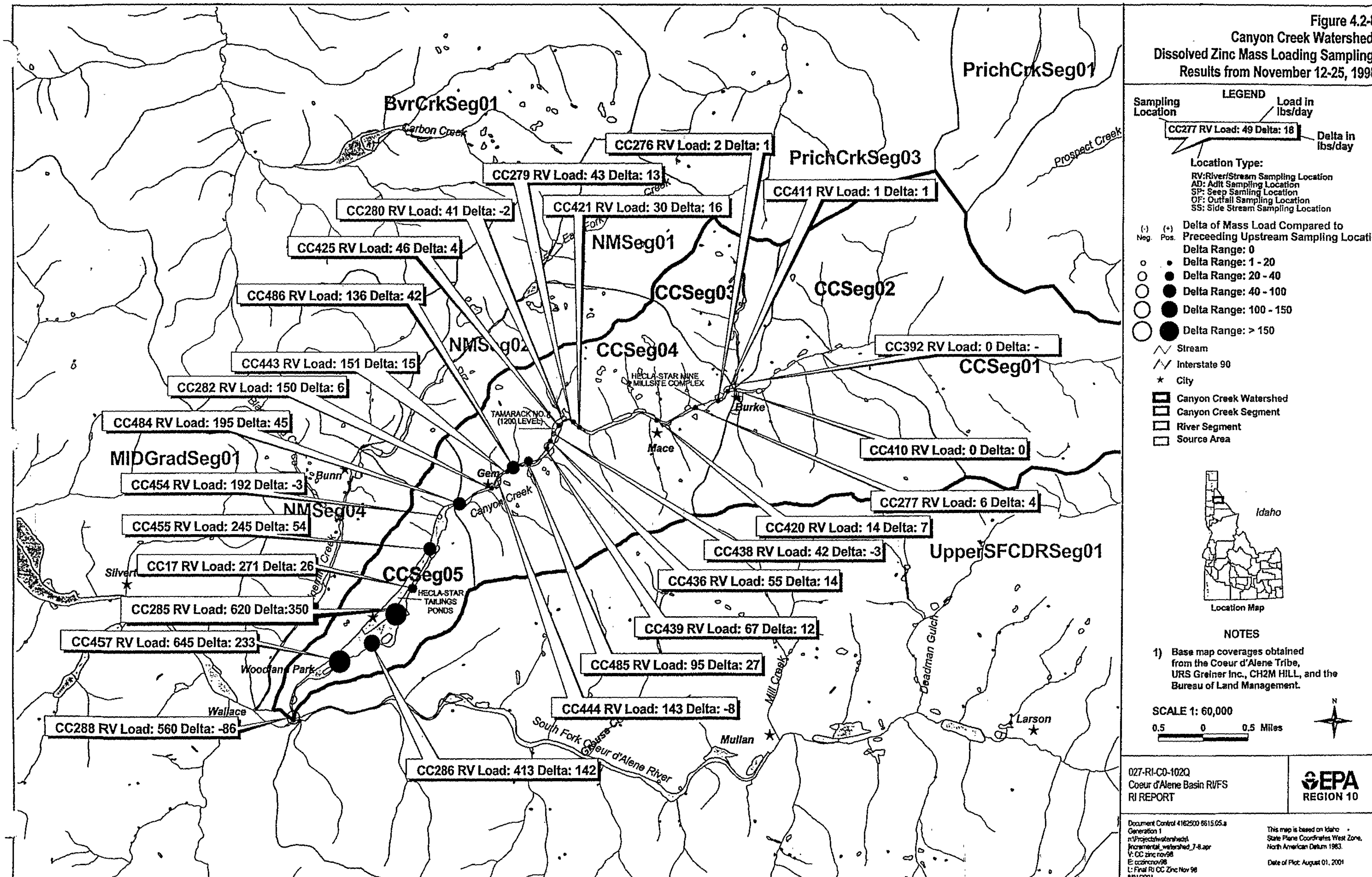


Figure 4.2-8
Canyon Creek Watershed
Dissolved Zinc Mass Loading Sampling
Results from November 12-25, 1998
LEGEND
Sampling Location
Load in lbs/day
CC277 RV Load: 49 Delta: 18
Delta in lbs/day
Location Type:
RV: River/Stream Sampling Location
AD: Adit Sampling Location
SP: Seep Samling Location
OF: Outfall Sampling Location
SS: Side Stream Sampling Location
(-) Neg.
(+) Pos.
Delta of Mass Load Compared to Preceeding Upstream Sampling Location
Delta Range: 0
Delta Range: 1 - 20
Delta Range: 20 - 40
Delta Range: 40 - 100
Delta Range: 100 - 150
Delta Range: > 150
Stream
Interstate 90
City
Canyon Creek Watershed
Canyon Creek Segment
River Segment
Source Area
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.
SCALE 1: 60,000
0.5 0 0.5 Miles
N
027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
Date of Plot: August 01, 2001
PrichCrkSeg01
BvrCrkSeg01
Carbon Creek
Prospect Creek
PrichCrkSeg03
NMSeg01
CCSeg03
CCSeg02
NMSeg02
CCSeg04
CCSeg01
MIDGradSeg01
NMSeg04
CCSeg05
UpperSFCDRSeg01
HECLA-STAR MINE MILLSITE COMPLEX
TAMARACK NO. 7 (1200 LEVEL)
HECLA-STAR TAILINGS PONDS
Burke
Mace
Gem
Bunn
Canyon Creek
Silverton
Woodland Park
Wallace
Mullan
Larson
Mill Creek
Deadman Gulch
South Fork Coeur d'Alene River
CC276 RV Load: 2 Delta: 1
CC279 RV Load: 43 Delta: 13
CC280 RV Load: 41 Delta: -2
CC421 RV Load: 30 Delta: 16
CC411 RV Load: 1 Delta: 1
CC425 RV Load: 46 Delta: 4
CC486 RV Load: 136 Delta: 42
CC443 RV Load: 151 Delta: 15
CC392 RV Load: 0 Delta: -
CC282 RV Load: 150 Delta: 6
CC484 RV Load: 195 Delta: 45
CC410 RV Load: 0 Delta: 0
CC454 RV Load: 192 Delta: -3
CC277 RV Load: 6 Delta: 4
CC455 RV Load: 245 Delta: 54
CC420 RV Load: 14 Delta: 7
CC438 RV Load: 42 Delta: -3
CC17 RV Load: 271 Delta: 26
CC436 RV Load: 55 Delta: 14
CC285 RV Load: 620 Delta:350
CC439 RV Load: 67 Delta: 12
CC457 RV Load: 645 Delta: 233
CC485 RV Load: 95 Delta: 27
CC444 RV Load: 143 Delta: -8
CC288 RV Load: 560 Delta: -86
CC286 RV Load: 413 Delta: 142

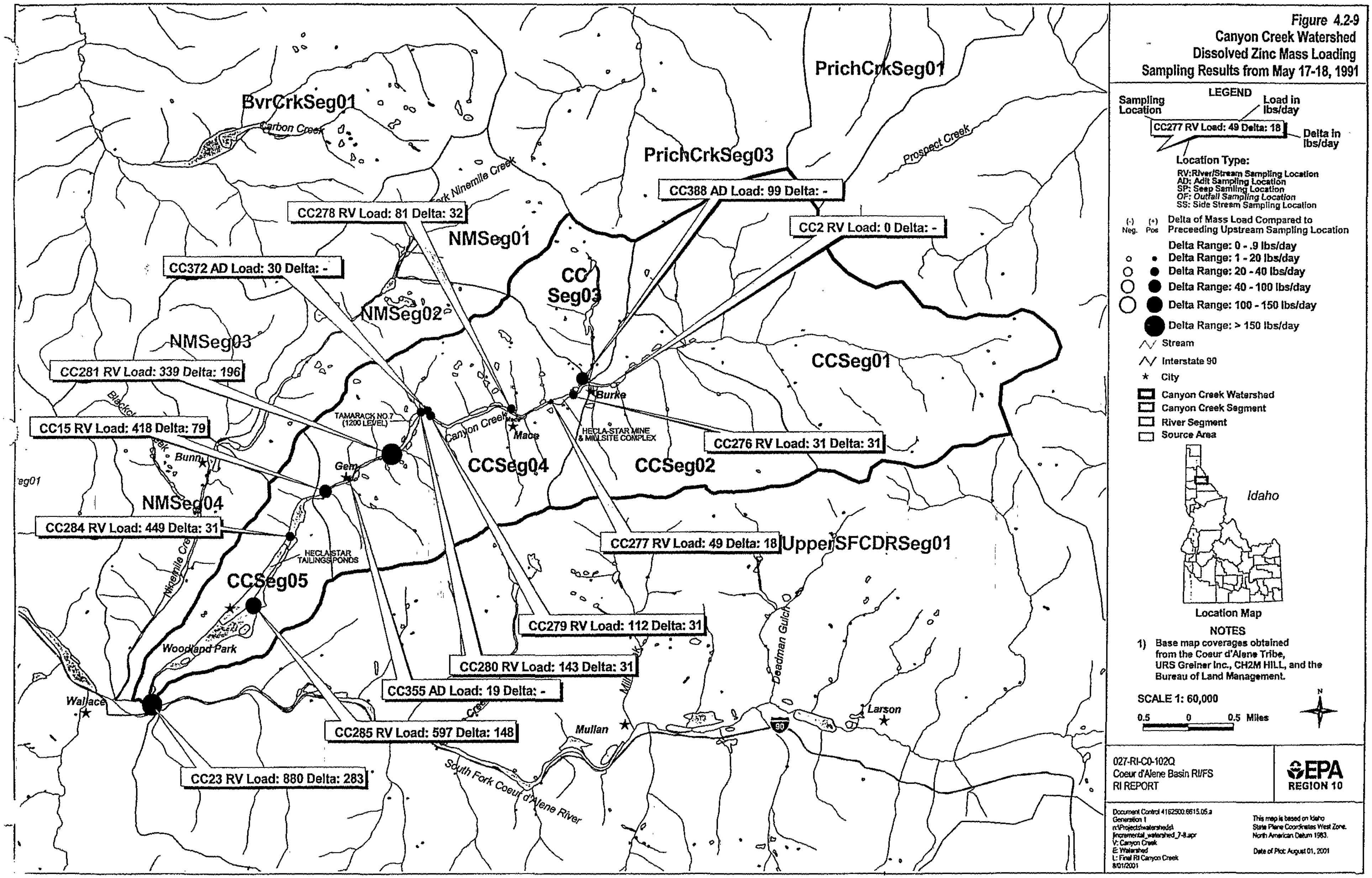


Figure 4.2-9
Canyon Creek Watershed
Dissolved Zinc Mass Loading
Sampling Results from May 17-18, 1991
LEGEND
Sampling Location
Load in lbs/day
CC277 RV Load: 49 Delta: 18
Delta in lbs/day
Location Type:
RV: River/Stream Sampling Location
AD: Adit Sampling Location
SP: Seep Samling Location
OF: Outfall Sampling Location
SS: Side Stream Sampling Location
(-) Neg. (+) Pos
Delta of Mass Load Compared to Preceeding Upstream Sampling Location
Delta Range: 0 - .9 lbs/day
Delta Range: 1 - 20 lbs/day
Delta Range: 20 - 40 lbs/day
Delta Range: 40 - 100 lbs/day
Delta Range: 100 - 150 lbs/day
Delta Range: > 150 lbs/day
Stream
Interstate 90
City
Canyon Creek Watershed
Canyon Creek Segment
River Segment
Source Area
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.
SCALE 1: 60,000
0.5 0 0.5 Miles
N
027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
This map is based on Idaho State Plane Coordinates West Zone. North American Datum 1983.
Date of Plot: August 01, 2001
BvrCrkSeg01
Carbon Creek
PrichCrkSeg01
PrichCrkSeg03
Prospect Creek
Ninemile Creek
CC388 AD Load: 99 Delta: -
CC278 RV Load: 81 Delta: 32
CC2 RV Load: 0 Delta: -
NMSeg01
CC372 AD Load: 30 Delta: -
CC
Seg03
NMSeg02
NMSeg03
CCSeg01
CC281 RV Load: 339 Delta: 196
Burke
TAMARACK NO.7 (1200 LEVEL)
Canyon Creek
Mace
HECLA-STAR MINE & MILLSITE COMPLEX
CC15 RV Load: 418 Delta: 79
CC276 RV Load: 31 Delta: 31
Gem
CCSeg04
CCSeg02
NMSeg04
CC284 RV Load: 449 Delta: 31
CC277 RV Load: 49 Delta: 18
UpperSFCDRSeg01
HECLA STAR TAILINGS PONDS
CCSeg05
CC279 RV Load: 112 Delta: 31
Deadman Gulch
Woodland Park
CC280 RV Load: 143 Delta: 31
CC355 AD Load: 19 Delta: -
Wallace
Larson
Mullan
CC285 RV Load: 597 Delta: 148
South Fork Coeur d'Alene River
CC23 RV Load: 880 Delta: 283

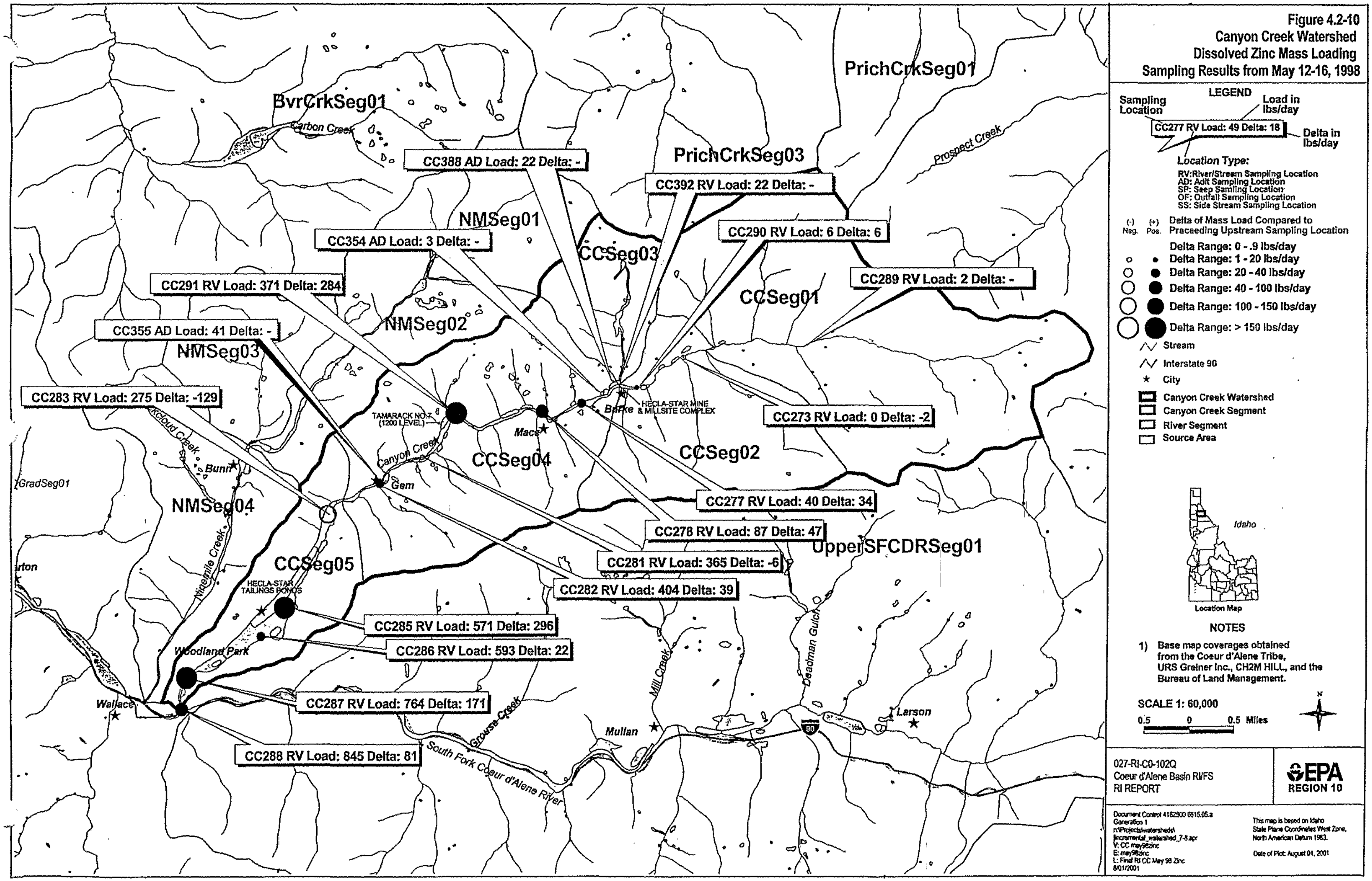


Figure 4.2-10
Canyon Creek Watershed
Dissolved Zinc Mass Loading
Sampling Results from May 12-16, 1998

Table 4.1-1
Potential Source Areas Within Canyon Creek - segment CCSeg01

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type		Metals > 1X	Metals > 10X	Metals > 100X
BURKE MINE	BUR110	0.29	Upland waste rock					
BURKE MINING COMPANY	THO017	0.54	Upland waste rock					
CENTRAL MINING COMPANY CLAIMS	BUR102	1.42	Upland waste rock					
COEUR D ALENE CHAMPION MINE (Champion Gold & Silver)	BUR188	0.43	Upland waste rock	SW	1			
HALF MOON MINE (Blue Ribbon Group)	THO018	0.20	Upland waste rock					
HOMESTAKE SILVER LEAD	BUR183	0.22	Upland waste rock					
IDAHO MINING COMPANY	THO016	0.13	Upland waste rock					
OOM PAUL NO. 1	BUR109	1.14	Upland waste rock (erosion potential)					
OOM PAUL NO. 2	BUR105	0.27	Upland waste rock (erosion potential)					
ORLANDO MINE	THO014	0.28	Upland waste rock					
UNIDENTIFIED DISTURBANCE	THO015	0.41	Upland waste rock					
UNNAMED ADIT	BUR182	0.16	Upland waste rock	SW	1	SWT: Cd-1		
UNNAMED ADIT	BUR184	0.21	Upland waste rock					
UNNAMED ADIT	BUR186	0.24	Upland waste rock					
UNNAMED ADIT	BUR187	0.25	Upland waste rock (erosion potential)					
UNNAMED ADIT	THO012	0.33	Upland waste rock					
UNNAMED ADIT	THO013	0.35	Upland waste rock					
UNNAMED ADIT	THO023	0.19	Upland waste rock (erosion potential)	SW	1			
WEST MAMMOTH MINE	BUR185	0.31	Upland waste rock (erosion potential)					

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.1-2
Potential Source Areas Within Canyon Creek - segment CCSeg02

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type		Metals > 1X	Metals > 10X	Metals > 100X
AJAX NO.3	BUR107	2.34	Upland waste rock (erosion potential)					
ALCIDES PROSPECT & IMPERIAL MINE	BUR134	0.60	Upland waste rock (erosion potential)					
CANYON CK GARBAGE DUMP	BUR150	1.36	Floodplain artificial fill Floodplain waste rock					
CANYON CK IMPACTED FLOODPLAIN (CCSeg02 & CCSeg04)	BUR153	7.20	Floodplain sediments	FI GW RK SB SL SW	1 5 3 4 3 5	GWD: Cd-4, Pb-3, Sb-3, Zn-3 GWT: Cd-4, Cu-1, Zn-2 SBT: As-3, Cd-1, Sb-1, Zn-1 SST: Cd-3, Cu-3, Fe-2, Pb-2, Zn-2 SWD: Cd-1, Pb-2, Sb-1 SWT: Zn-2	GWD: Zn-1 GWT: Zn-2 SBT: Pb-1, Zn-1 SST: Pb-3, Zn-2	
CANYON CK ROCKPIT	BUR151	1.76	Upland waste rock	SL	1			
COPPER KING MINE UPPER ADIT	BUR138	0.58	Upland waste rock					
ECHO GROUP	BUR106	0.25	Upland waste rock					
GERTIE MINE	BUR132	1.67	Adit drainage Upland waste rock (erosion potential)	RK	1	SST: Fe-1		
MARSH MINE	BUR130	2.38	Upland waste rock (erosion potential)					
NEVERSWEAT MINE	BUR100	0.25	Upland waste rock					
ONEILL GULCH UNNAMED ROCK DUMP	BUR145	2.54	Upland waste rock (erosion potential)					
RUSSEL MINE	BUR133	0.22	Upland waste rock (erosion potential)					
SONORA MINE	BUR135	0.58	Upland waste rock (erosion potential)	SL	1			
UNIDENTIFIED DISTURBANCE	BUR131	0.45	Upland waste rock					

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.1-3
Potential Source Areas Within Canyon Creek - segment CCSeg03

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
AJAX NO.2	BUR088	0.00					
AJAX NO.2 ADJACENT ROCK DUMP	BUR149	0.51	Upland waste rock (erosion potential)				
BENTON MINE	BUR099	0.21	Upland waste rock				
FAIRVIEW/WIDE WEST MINE	BUR092	0.19	Upland waste rock				
GORGE GULCH IMPACTED RIPARIAN	BUR146	5.18	Floodplain sediments	GW 2 RK 1 SW 5	GWD: Cd-1, Pb-2, Sb-2 GWT: Pb-1, Sb-2, Zn-2 SWD: Cd-4, Mn-1, Pb-1, Sb-1, Zn-4 SWT: Mn-1, Pb-4, Sb-1, Zn-5	SWD: Pb-3, Sb-2 SWT: Pb-1, Sb-1	
GORGE GULCH IMPACTED RIPARIAN	BUR168	2.20	Floodplain sediments				
GORGE GULCH IMPACTED RIPARIAN	BUR169	3.13	Floodplain sediments				
HERCULES NO. 1 & ASSOCIATED PITS	BUR085	0.41	Upland waste rock	SW 1	SWD: Cu-1, Mn-1, Zn-1 SWT: Mn-1, Zn-1		
HERCULES NO. 2	BUR086	1.67	Upland waste rock				
HERCULES NO. 3	BUR087	3.88	Upland waste rock (erosion potential)				
HERCULES NO. 4	BUR090	10.49	Upland tailings Upland waste rock (erosion potential)	RK 5 SL 2	SST: Cd-1, Cu-1, Fe-1, Pb-2	SST: Pb-3, Zn-1	
HONOLULU MINE	BUR165	0.21	Upland waste rock				
IDAHO AND EASTERN MINE	BUR089	0.20	Upland waste rock (erosion potential)				
SMUGGLER-VIRGINA	BUR101	0.24	Upland waste rock				
STANLEY MINE	BUR180	0.23	Upland waste rock (erosion potential)				
TRADE DOLLAR MINE	BUR091	0.29	Upland waste rock				
UNNAMED ADIT	BUR164	0.17					
UNNAMED ADIT	BUR166	0.33	Upland waste rock (erosion potential)				
UNNAMED ADIT	BUR167	0.42	Upland waste rock				
UNNAMED ADIT	BUR179	0.24	Upland waste rock				

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.1-4
Potential Source Areas Within Canyon Creek - segment CCSeg04

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
ALBANY LEAD MINING COMPANY	BUR126	0.47	Upland waste rock				
ANCHOR MINE	BUR096	1.42	Adit drainage Upland waste rock	SW 1			
BELL OF THE WEST MINE	BUR063	1.89	Upland waste rock				
BETTY LOU MINE	BUR113	0.27	Upland waste rock				
BIG DIVIDE	BUR064	0.41	Upland waste rock				
BLACK BEAR FRACTION	BUR121	2.01	Adit drainage Upland waste rock (erosion potential)	SW 2	SWD: Cd-1, Pb-1, Zn-1 SWT: Zn-1		
BLACK BEAR MILLSITE	BUR192	1.12	Floodplain tailings (discrete site) Upland waste rock (erosion potential)	SS 1 SW 6	SST: As-1, Cd-1, Cu-1, Sb-1 SWD: Cd-2, Mn-2, Pb-3, Sb-2, Zn-2 SWT: Cd-4, Cu-1, Pb-5, Zn-1	SST: Zn-1 SWD: Cd-3, Pb-2, Zn-3 SWT: Zn-4	SST: Pb-1
BLACK BEAR NO.2	BUR194	0.69	Upland waste rock				
BLACK BEAR NO.3	BUR193	0.75	Upland waste rock				
BLACK BEAR NO.4	BUR119	2.08	Upland waste rock				
CANYON CK IMPACTED FLOODPLAIN	BUR141	15.41	Floodplain sediments	DR 1 FI 2 GW 4 RK 6 SB 2 SD 6 SL 4 SU 1 SW 36	GWD: Cd-4, Zn-4 GWT: Zn-4 SBT: Zn-1 SDT: Ag-2, As-2, Cd-2, Cu-3, Fe-3, Hg-1, Mn-2, Zn-1 SST: Cd-2, Cu-2, Fe-5, Pb-5, Zn-4 SWD: Ag-1, Cd-6, Mn-11, Pb-2, Sb-9, Zn-4 SWT: Cd-34, Cu-6, Fe-6, Mn-9, Pb-27, Sb-5, Zn-1	SDT: Cd-4, Hg-2, Pb-3, Sb-2, Zn-4 SST: Cd-1, Pb-4, Zn-3 SWD: Cd-29, Pb-32, Zn-31 SWT: Pb-7, Zn-34	SDT: Pb-3, Zn-1 SST: Pb-1, Zn-2 SWD: Pb-1 SWT: Mn-1, Pb-1
CANYON CK IMPACTED RIPARIAN	BUR143	39.03	Floodplain sediments	GW 14 RK 8 SB 9 SL 1 SW 40	GWD: Cu-4, Sb-7 GWT: Cd-1, Pb-3, Sb-7 SBT: Mn-1, Pb-4, Zn-4 SST: Cd-1, Cu-1, Fe-1, Pb-4, Zn-4 SWD: Cd-13, Mn-17, Pb-22, Sb-18, Zn-8 SWT: Cd-34, Fe-2, Mn-3, Pb-26, Sb-8, Zn-4	GWD: Cd-3, Pb-3, Zn-2 GWT: Cd-4, Cu-4, Pb-4 SST: Pb-1, Zn-1 SWD: Cd-26, Pb-16, Zn-31 SWT: Cu-1, Zn-35	GWD: Cd-4, Pb-4, Zn-5 GWT: Cd-2, Zn-7
CUSTER PEAK EXPLORATION PITS	BUR174	5.06	Upland waste rock				
DULUTH MINE CANYON CK	BUR189	0.20	Upland waste rock (erosion potential)				
EAST ALAMEDA MINE	BUR065	1.01	Upland waste rock				
EAST STANDARD MINE	BUR127	0.17	Upland waste rock				
FLYNN MINE	BUR122	1.12	Upland waste rock (erosion potential)				

Table 4.1-4
Potential Source Areas Within Canyon Creek - segment CCSeg04

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type		Metals > 1X	Metals > 10X	Metals > 100X
FRISCO MILLSITE	BUR117	1.11	Upland tailings Upland waste rock (potential intermixed tailings)					
FRISCO NO.2 & NO.1	BUR118	1.39	Upland waste rock (erosion potential)					
FRISCO NO.3	BUR191	1.55	Upland waste rock					
GEM MILLSITE	BUR142	3.02	Upland tailings Upland waste rock (potential intermixed tailings)	SW	1	SWD: Mn-1, Sb-1 SWT: Cd-1, Cu-1, Fe-1, Mn-1, Sb-1	SWD: Cd-1, Pb-1, Zn-1 SWT: Pb-1, Zn-1	
GEM NO.2	BUR112	1.32	Upland waste rock					
GEM NO.3	BUR190	0.40	Adit drainage	SW	4	SWD: Fe-1 SWT: Cd-3, Pb-3	SWD: Cd-3 SWT: Fe-1	SWD: Mn-1, Zn-2 SWT: Mn-1, Zn-2
GOODENOUGH GROUP	BUR116	0.33	Upland waste rock (erosion potential)					
GREAT EASTERN MINE	BUR123	0.16	Upland waste rock (erosion potential)					
GREENHILL CLEVELAND MINE	BUR203	0.12	Upland waste rock					
HEADLIGHT MINE	BUR068	0.49	Upland waste rock (erosion potential)					
HECLA-STAR MINE & MILLSITE COMPLEX	BUR128	9.37	Adit drainage Buildings & structures Upland tailings Upland waste rock	GW SB SW	2 3 48	GWD: Sb-2 GWT: Cd-1, Cu-1, Pb-1 SBT: As-1, Cu-1, Pb-1, Sb-1, Zn-2 SWD: Cd-41, Mn-4, Pb-40, Sb-3, Zn-40 SWT: Cd-1, Fe-2, Mn-2, Pb-5, Sb-1, Zn-47	GWD: Cd-1, Pb-1, Zn-1 GWT: Cd-1, Pb-1, Zn-1 SBT: Cd-1, Pb-1 SWD: Zn-1 SWT: Mn-2, Pb-1, Zn-1	GWD: Cd-1, Pb-1, Zn-1 GWT: Zn-1 SBT: Pb-1, Zn-1
HERCULES NO. 5	BUR098	2.73	Adit drainage Buildings & structures Upland waste rock (potential intermixed tailings)	GW RK SB SL SS SW	2 14 2 1 6 5	GWD: Cd-2, Zn-2 GWT: Zn-2 SBT: As-1, Pb-1, Zn-1 SST: As-4, Cd-10, Cu-5, Fe-7, Pb-9, Sb-2, Zn-11 SWD: Cd-1, Mn-1, Pb-1, Zn-1 SWT: Cd-1, Cu-1, Fe-1, Mn-2, Pb-2, Zn-2	SST: Cu-1, Pb-7, Zn-4 SWD: Cd-1, Mn-1, Pb-1, Zn-1 SWT: Cd-2, Mn-1, Pb-1, Zn-2	SST: As-1, Pb-3 SWD: Cd-1, Pb-1, Zn-1 SWT: Zn-1
HIDDEN TREASURE MINE	BUR097	0.87	Adit drainage Upland waste rock	SW	2	SWD: Cd-1, Zn-1 SWT: Cd-1, Fe-1, Pb-1	SWD: Mn-1 SWT: Mn-1, Zn-1	
HUMMINGBIRD MINE	BUR093	0.14	Upland waste rock					
JOE MATT MINE	BUR177	0.68	Upland waste rock (erosion potential)					
MIDVALE MNG CO CLAIMS/ANCHOR GROUP	BUR095	0.22	Upland waste rock (erosion potential)					
MIDWAY SUMMIT MINE	BUR125	0.32	Upland waste rock (erosion potential)					
MOONLIGHT MINE	BUR066	0.30	Upland waste rock (erosion potential)					
OMAHA MINE	BUR124	1.00	Upland waste rock (erosion potential)					

Table 4.1-4
Potential Source Areas Within Canyon Creek - segment CCSeg04

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
SHERMAN 1000 LEVEL (OREANO ADIT)	BUR075	1.75	Upland tailings Upland waste rock	RK 5 SL 3	SST: Cd-2, Cu-1, Fe-2, Pb-1, Zn-5	SST: Cu-1, Pb-3	SST: Pb-3
SHERMAN 1500 LEVEL	BUR076	0.11	Upland waste rock				
SHERMAN 600 LEVEL	BUR094	1.40	Upland waste rock (erosion potential)				
SILVER MOON MINE	BUR120	0.93	Upland waste rock (erosion potential)				
STANDARD-MAMMOTH CAMPBELL ADIT	BUR073	5.27	Upland waste rock (erosion potential)	PL 6 RK 8 SL 1	SST: Fe-1, Pb-2, Zn-2		
STANDARD-MAMMOTH LOADING AREA	BUR144	2.54	Upland waste rock (erosion potential)				
STANDARD-MAMMOTH NO.1 & UNNAMED ADIT	BUR070	2.81	Upland waste rock				
STANDARD-MAMMOTH NO.2	BUR069	1.05	Upland waste rock				
STANDARD-MAMMOTH NO.3	BUR071	1.97	Upland waste rock				
STANDARD-MAMMOTH NO.4	BUR072	1.74	Upland waste rock (erosion potential)				
STANDARD-MAMMOTH NO.5	BUR074	1.72	Upland waste rock	RK 5	SST: Cd-1, Cu-3, Fe-1, Pb-1, Zn-4	SST: Pb-2	SST: Pb-1
TAMARACK NO.7 (1200 LEVEL)	BUR067	9.50	Adit drainage Upland tailings Upland waste rock (potential intermixed tailings)	SS 3 SW 43	SST: As-2, Cu-2, Pb-1, Sb-1 SWD: Cd-22, Mn-4, Pb-22, Sb-3, Zn-15 SWT: Cd-37, Fe-2, Mn-2, Pb-29, Sb-1, Zn-9	SST: Cd-1, Pb-1, Zn-2 SWD: Cd-20, Mn-2, Pb-17, Zn-28 SWT: Zn-34	SST: Pb-1
TIGER-POORMAN MINE	BUR129	1.89	Upland tailings Upland waste rock (potential intermixed tailings)				
UNIDENTIFIED DISTURBANCE	BUR198	1.35	Upland waste rock				
UNIDENTIFIED DISTURBANCE	BUR199	0.32	Upland waste rock				
UNIDENTIFIED DISTURBANCE	BUR200	0.23	Upland waste rock				
UNIDENTIFIED DISTURBANCE	BUR201	0.10					
UNNAMED ADIT	BUR175	0.25	Upland waste rock				
UNNAMED ADIT	BUR176	0.56	Upland waste rock (erosion potential)				
UNNAMED ADIT	BUR195	0.42	Upland waste rock				
UNNAMED ROCK DUMP	BUR204	0.19	Upland waste rock (erosion potential)				
UNNAMED ROCK DUMPS	BUR202	0.11	Upland waste rock				
WALLACE MINING COMPANY	BUR115	0.59	Upland waste rock				
WEST BELL MINE	BUR111	0.24	Upland waste rock				
WEST HECLA MINE	BUR178	0.46	Upland waste rock (erosion potential)				
WEST STAR MINE	BUR114	1.17	Upland waste rock (erosion potential)				

Table 4.1-4
Potential Source Areas Within Canyon Creek - segment CCSeg04

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.1-5
Potential Source Areas Within Canyon Creek - segment CCSeg05

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
CANYON CK FORMOSA REACH SVNRT REHAB	OSB047	30.02	Floodplain sediments Groundwater	GW 8 SB 4 SD 3 SS 6 SW 56	GWD: Cu-5 GWT: Pb-2 SBT: Cd-1, Zn-1 SDT: Ag-1, As-1, Cd-1, Cu-1, Fe-1, Hg-1, Mn-2, Sb-1, Zn-1 SST: As-5, Cd-4, Cu-5, Mn-1, Zn-3 SWD: Cd-7, Mn-12, Pb-4, Sb-10, Zn-4 SWT: Cd-52, Cu-5, Fe-3, Mn-10, Pb-48, Sb-3	GWD: Ag-1, Cd-1, Pb-2, Zn-1 GWT: Cd-5, Cu-5, Pb-5, Zn-1 SBT: Pb-1 SDT: Ag-2, Cd-2, Cu-2, Hg-1, Pb-1, Sb-2, Zn-1 SST: Pb-4, Zn-3 SWD: Cd-46, Pb-48, Zn-50 SWT: Cd-1, Cu-2, Pb-4, Zn-54	GWD: Cd-6, Pb-5, Zn-6 GWT: Cd-2, Zn-6 SDT: Hg-1, Pb-2, Zn-1 SST: Pb-2 SWD: Cd-1, Pb-1 SWT: Cd-1, Pb-1
CANYON CK GRAVEL PIT	WAL007	0.44	Upland waste rock				
CANYON CK IMPACTED FLOODPLAIN	WAL040	26.16	Floodplain sediments Groundwater	GW 4 SB 2 SW 108	GWD: Pb-2 GWT: Pb-1 SBT: Zn-1 SWD: Cd-1, Mn-12, Pb-1, Sb-5 SWT: Cd-66, Cu-5, Fe-2, Mn-9, Pb-83, Sb-1	GWD: Cd-1, Pb-1, Zn-1 GWT: Cd-3, Zn-1 SBT: Pb-1 SWD: Cd-101, Pb-100, Zn-89 SWT: Cd-41, Cu-1, Fe-1, Mn-1, Pb-20, Zn-67	GWD: Cd-2, Zn-2 GWT: Zn-2 SWD: Cd-4, Pb-4, Zn-16 SWT: Pb-3, Zn-40
CANYON CK POND REACH SVNRT REHAB	WAL010	25.81	Floodplain sediments Groundwater	GW 5 SB 2 SS 1 SW 2	GWD: Cu-5, Mn-2, Pb-5 GWT: Cu-2, Mn-1 SST: As-1, Cd-1, Cu-1 SWD: Mn-1, Pb-1, Sb-1 SWT: Cd-2, Fe-1, Mn-1, Pb-2, Sb-1	GWT: Cd-2, Cu-3 SST: Pb-1, Zn-1 SWD: Cd-2, Pb-1, Zn-2 SWT: Zn-2	GWD: Cd-5, Zn-5 GWT: Cd-3, Zn-5
CANYON CK REPOSITORY REACH SVNRT REHAB	WAL041	88.57	Floodplain sediments Groundwater Seep	FL 6 GW 144 PL 17 RK 2 SB 8 SD 7 SL 19 SS 10 SW 72	GWD: Cu-10, Mn-1, Pb-3, Sb-3, Zn-1 GWT: As-7, Cd-1, Cu-1, Fe-1, Mn-2, Pb-9 SBT: Zn-3 SDT: Ag-3, As-3, Cd-6, Cu-3, Hg-3, Mn-1, Sb-2, Zn-6 SST: As-5, Cd-15, Cu-10, Mn-3, Pb-7, Sb-2, Zn-20 SWD: Cd-7, Mn-10, Pb-3, Sb-7, Zn-2 SWT: Cd-60, Cu-4, Fe-2, Mn-9, Pb-54, Sb-3, Zn-1	GWD: Cd-11, Cu-6, Mn-6, Pb-24, Zn-12 GWT: Cd-25, Cu-3, Mn-5, Pb-10, Zn-2 SBT: Pb-1 SDT: Hg-1, Pb-4 SST: Cd-1, Pb-18, Zn-6 SWD: Cd-62, Pb-64, Zn-67 SWT: Cd-8, Fe-1, Pb-11, Zn-65	GWD: Ag-1, Cd-130, Mn-2, Pb-112, Zn-130 GWT: Cd-20, Mn-2, Pb-24, Zn-44 SDT: Pb-1 SST: Pb-2 SWD: Cd-1, Pb-2, Zn-1 SWT: Cd-1, Pb-4, Zn-5
CANYON CK TAILINGS REPOSITORY SVNRT	WAL042	5.15	Floodplain sediments Floodplain tailings				
CANYON SILVER (FORMOSA) MINE	WAL011	4.15	Adit drainage Floodplain sediments Upland tailings				

Table 4.1-5
Potential Source Areas Within Canyon Creek - segment CCSeg05

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
HECLA-STAR TAILINGS PONDS	WAL009	61.55	Floodplain sediments (underlying tailings pond) Floodplain tailings Groundwater Seep	GW 5 SB 2 SW 110	GWD: Cu-2, Mn-1, Pb-2 GWT: Fe-1, Pb-3 SBT: Pb-1, Zn-1 SWD: Cu-1 SWT: Cd-82, Cu-1, Mn-1, Pb-51, Zn-9	GWD: Cu-3, Pb-3 GWT: Cd-5, Cu-5 SWD: Pb-1 SWT: Cd-3, Pb-3, Zn-98	GWD: Cd-5, Zn-5 GWT: Zn-5 SWD: Cd-1, Mn-1
SISTERS MINE	WAL008	0.57	Upland waste rock				
STANDARD-MAMMOTH MILLSITE	WAL039	1.96	Upland tailings Upland waste rock				
VERDE MAY MINE	WAL012	0.09	Upland waste rock				
WALLACE OLD PRIVATE LANDFILL	WAL081	2.65	Floodplain artificial fill				

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.1-6
Adit and Seep Data Summary

BLM ID	Source Name	Average Discharge (cfs)	Maximum Discharge (cfs)	Average Total Zinc Concentration, (µg/L)	Average Total Zinc Load (lbs/day)
Adits					
BUR098	Hercules No. 5	1.96	3.0	1,693	18
BUR067	Tamarack No. 7	1.58	3.15	1,437	12
BUR097	Hidden Treasure (Tiger-Poorman)	1.44	1.44	392	3.0
BUR121	Black Bear Fraction	1.13	1.13	91	0.55
BUR128	Hecla No. 3	0.33	0.33	63	0.11
BUR096	Anchor	0.0081	0.0081	22	0.00097
BUR132	Gertie	0.6	0.6	No data	No data
WAL011	Canyon Silver (Formosa)	No data	No data	208	No discharge data
BUR073	Standard-Mammoth Campbell Adit	No data	No data	No data	No data
BUR076	Sherman 1500 Level	No data	No data	No data	No data
BUR085	Hercules No. 1	No data	No data	No data	No data
BUR087	Hercules No. 3	No data	No data	No data	No data
BUR088	Ajax No. 2	No data	No data	No data	No data
BUR091	Trade Dollar	No data	No data	No data	No data
BUR099	Benton	No data	No data	No data	No data
BUR107	Ajax No. 3	No data	No data	No data	No data
BUR109	Oom Paul No. 1	No data	No data	No data	No data
BUR112	Gem No. 2	No data	No data	No data	No data
BUR114	West Star	No data	No data	No data	No data
BUR123	Great Eastern	No data	No data	No data	No data
BUR124	Omaha	No data	No data	No data	No data
BUR129	Tiger-Poorman	No data	No data	No data	No data
BUR134	Alcides Prospect & Imperial Mine	No data	No data	No data	No data
BUR185	West Mammoth	No data	No data	No data	No data
BUR188	Coeur d'Alene Champion	No data	No data	No data	No data

Table 4.1-6 (Continued)
Adit and Seep Data Summary

BLM ID	Source Name	Average Discharge (cfs)	Maximum Discharge (cfs)	Average Total Zinc Concentration, (µg/L)	Average Total Zinc Load (lbs/day)
THO018	Half Moon (Blue Ribbon Group)	No data	No data	No data	No data
Seeps					
WAL009	Hecla-Star Tailings Ponds	1.03	1.1	1,400	7.8
WAL041	Canyon Cr. Repository Reach	0.02	0.02	32,000	3.4
BUR107	Ajax No. 3	No data	No data	No data	No data

Notes:
Data compiled from the Restorations Alternative Plan (Gearheart et al. 1999). See Appendix J.
cfs - cubic feet per second
µg/L - micrograms per liter
lbs/day - pounds per day

Table 4.2-1
Results of Chemical Correlation Analysis

	CSM Unit 1			CSM Unit 2			CSM Unit 3		
Chemical	**n**	**r**	**1-a**	**n**	**r**	**1-a**	**n**	**r**	**1-a**
Correlations Between Dissolved Chemical Concentrations, [dC]; and Dissolved Zinc Concentration, [dZn]: Linear Regression: Log[dC] = m Log[dZn] + b									
Antimony	139	0.31	>.99	65	0.18	0.92	3	0.98	0.92
Arsenic	90	0.12	0.87	55	0.96	>.99	1	ID	ID
Cadmium	1301	0.94	>.99	697	0.87	>.99	260	0.69	>.99
Copper	92	0.13	0.89	54	0.35	>.99	2	1.00	0.50
Iron	273	0.18	>.99	77	0.10	0.82	5	0.60	0.87
Lead	1237	0.82	>.99	683	0.59	>.99	261	0.15	>.99
Manganese	236	0.62	>.99	98	0.65	>.99	7	0.68	0.96
Mercury	1	ID	ID	5	0.60	0.87	0	ID	ID
Silver	2	ID	ID	1	ID	ID	0	ID	ID
Correlations Between Total Chemical Concentrations, [tC]; and Total Lead Concentration, [tPb]: Linear Regression: Log[tC] = m Log[tPb] + b									
Antimony	129	0.41	>.99	97	0.27	>.99	1	ID	ID
Arsenic	84	0.40	>.99	79	0.40	>.99	0	ID	ID
Cadmium	1209	0.73	>.99	1257	0.39	>.99	84	0.06	0.71
Copper	119	0.56	>.99	105	0.61	>.99	1	ID	ID
Iron	224	0.63	>.99	142	0.55	>.99	3	0.99	>.99
Manganese	250	0.76	>.99	162	0.77	>.99	4	0.81	0.93
Mercury	6	0.44	0.81	11	0.60	0.98	0	ID	ID
Silver	4	0.93	0.98	1	ID	ID	0	ID	ID
Zinc	1349	0.73	>.99	1344	0.52	>.99	83	0.15	0.91

Notes:
m = slope and b = intercept of the linear regression line (m and b are not reported here)
n = number of samples used in the regression analysis
r = correlation coefficient between the chemicals
1-a = probability that there is correlation (r>0) between the chemicals
ID = Insufficient data to calculate r or a

Table 4.2-2
Mass Load Sampling Events

Location	CSM Segment	Sample Type	Sample ID	Sample Date	Flow (CFS)	Flow Delta	TOTAL LEAD Conc. (µg/L)	TOTAL LEAD Load (lbs/day)	TOTAL LEAD Delta[1] (lbs/day)	DISSOLVED ZINC Conc (µg/L)	DISSOLVED ZINC Load (lbs/day)	DISSOLVED ZINC Delta[1] (lbs/day)
CC2	02	RV	172030	18-May-91	99.3	-	8.0	4.3	-	-	-	-
CC276	04	RV	172033	18-May-91	101.0	1.7	85.0	46.3	42	57.0	31.0	31
CC277	04	RV	172034	18-May-91	117.3	16.3	177.0	111.9	66	77.0	48.7	18
CC278	04	RV	172035	17-May-91	101.6	-15.7	14.0	7.7	-104	148.0	81.0	32
CC279	04	RV	172036	17-May-91	99.1	-2.5	10.0	5.3	-2	210.0	112.2	31
CC280	04	RV	172038	17-May-91	83.2	-16.0	15.0	6.7	1	320.0	143.4	31
CC281	04	RV	172039	17-May-91	229.5	146.4	26.0	32.2	25	274.0	338.9	196
CC15	04	RV	172040	17-May-91	191.4	-38.1	21.0	21.7	-11	405.0	417.7	79
CC284	05	RV	172041	17-May-91	171.6	-19.8	21.0	19.4	-2	485.0	448.6	31
CC285	05	RV	172042	17-May-91	199.5	27.9	24.0	25.8	6	555.0	596.8	148
CC23	05	RV	172012	17-May-91	180.3	-19.2	30.0	29.2	3	905.0	879.5	283
CC355	04	AD	172014	17-May-91	0.2	-	30.0	<0.1	-	17300.0	18.6	-
CC372	04	AD	172037	17-May-91	3.2	-	0.0	<0.1	-	1720.0	29.7	-
CC388	04	AD	172032	18-May-91	2.8	-	838.0	12.6	-	6550.0	98.9	-
CC289	01	RV	46569	15-May-98	77.0	-	0.5	0.2	-	5.4	2.2	-
CC273	02	RV	46568	15-May-98	130.0	53.0	1.0	0.7	-	-	-	-
CC290	02	RV	46567	15-May-98	194.0	64.0	-	-	-	5.8	6.1	6
CC277	02	RV	46566	15-May-98	165.0	35.0	3.4	3.0	2	44.6	39.7	34
CC278	04	RV	46564	14-May-98	206.0	41.0	6.6	7.3	4	78.0	86.6	47
CC291	04	RV	46563	14-May-98	274.0	68.0	10.6	15.7	8	251.0	370.7	284
CC281	04	RV	46562	14-May-98	309.0	103.0	16.9	28.1	12	219.0	364.7	-6
CC282	04	RV	46561	14-May-98	238.0	-71.0	32.5	41.7	14	315.0	404.1	39
CC283	05	RV	46573	15-May-98	156.0	-82.0	30.3	25.5	-16	327.0	275.0	-129
CC285	05	RV	46560	14-May-98	223.0	67.0	43.1	51.8	26	475.0	570.9	296
CC286	05	RV	46570	15-May-98	187.0	-36.0	44.6	45.0	-7	588.0	592.7	22
CC287	05	RV	46558	14-May-98	206.0	19.0	48.8	54.2	9	688.0	763.9	171
CC288	05	RV	46557	14-May-98	233.0	27.0	51.1	64.2	10	673.0	845.2	81
CC392	03	SS	46575	15-May-98	11.0	-	27.4	1.6	-	363.0	21.5	-
CC354	04	AD	46302	13-May-98	1.4	-	17.4	0.1	-	363.0	2.8	-
CC355	04	AD	46301	12-May-98	0.6	-	25.0	0.1	-	13200.0	41.3	-
CC388	04	AD	46299	12-May-98	1.9	-	49.0	0.5	-	2120.0	21.9	-
CC1	02	RV	172136	5-Oct-91	2.6	-	1.0	<0.1	-	-	-	-
CC2	02	RV	172157	5-Oct-91	3.6	0.9	2.0	<0.1	-	-	-	-
CC276	04	RV	172139	5-Oct-91	6.5	2.9	13.0	0.5	-	136.0	4.8	5
CC277	04	RV	172140	5-Oct-91	10.2	3.7	11.0	0.6	-	173.0	9.5	5
CC278	04	RV	172141	5-Oct-91	10.3	0.1	16.0	0.9	-	321.0	17.8	8
CC279	04	RV	172142	5-Oct-91	11.2	0.9	26.0	1.6	1	522.0	31.5	14

Table 4.2-2 (Continued)
Mass Load Sampling Events

Location	CSM Segment	Sample Type	Sample ID	Sample Date	Flow (CFS)	Flow Delta	TOTAL LEAD Conc. (µg/L)	TOTAL LEAD Load (lbs/day)	TOTAL LEAD Delta[1] (lbs/day)	DISSOLVED ZINC Conc (µg/L)	DISSOLVED ZINC Load (lbs/day)	DISSOLVED ZINC Delta[1] (lbs/day)
CC280	04	RV	172144	5-Oct-91	12.5	1.3	68.0	4.6	3	564.0	38.0	6
CC281	04	RV	172145	5-Oct-91	11.8	-0.7	17.0	1.1	-4	632.0	40.2	2
CC15	04	RV	172147	5-Oct-91	11.9	0.1	26.0	1.7	1	1080.0	69.3	29
CC284	05	RV	172148	5-Oct-91	16.1	4.2	29.0	2.5	1	999.0	86.7	17
CC17	05	RV	172149	5-Oct-91	13.4	-2.7	35.0	2.5	-	1450.0	104.7	18
CC285	05	RV	172150	5-Oct-91	14.2	0.8	34.0	2.6	-	1740.0	133.2	28
CC286	05	RV	172153	5-Oct-91	16.2	2.0	44.0	3.8	1	2490.0	217.4	84
CC287	05	RV	172154	5-Oct-91	14.5	-1.7	55.0	4.3	-	3440.0	268.9	51
CC23	05	RV	172155	5-Oct-91	17.8	3.3	52.0	5.0	1	3660.0	351.1	82
CC355	04	AD	172146	5-Oct-91	0.3	NA	40.0	0.1	-	14100.0	19.0	-
CC410	02	RV	49003	12-Nov-98	5.1	-	0.3	<0.1	-	10.6	0.3	-
CC411	04	RV	49004	12-Nov-98	6.6	1.5	3.4	0.1	-	39.0	1.4	1
CC276	04	RV	48861	12-Nov-98	8.1	1.5	4.9	0.2	-	47.8	2.1	1
CC277	04	RV	49005	12-Nov-98	8.0	-0.1	6.2	0.3	-	149.0	6.4	4
CC420	04	RV	49006	12-Nov-98	8.4	0.4	10.0	0.5	-	303.0	13.7	7
CC421	04	RV	49007	12-Nov-98	8.4	-	20.3	0.9	-	655.0	29.5	16
CC279	04	RV	48862	12-Nov-98	10.5	2.2	22.0	1.2	-	757.0	42.9	13
CC280	04	RV	49008	12-Nov-98	10.6	0.1	20.7	1.2	-	709.0	40.5	-2
CC425	04	RV	48863	12-Nov-98	9.8	-0.8	23.7	1.3	-	843.0	44.5	4
CC438	04	RV	49009	12-Nov-98	9.9	0.1	21.7	1.2	-	780.0	41.5	-3
CC436	04	RV	49012	13-Nov-98	12.2	2.3	70.9	4.7	3	841.0	55.2	14
CC439	04	RV	48864	13-Nov-98	13.6	1.5	80.0	5.9	1	917.0	67.4	12
CC485	04	RV	49013	13-Nov-98	17.4	3.8	124.0	11.6	6	1010.0	94.7	27
CC486	04	RV	49014	13-Nov-98	23.4	6.0	180.0	22.7	11	1080.0	136.4	42
CC443	04	RV	49015	13-Nov-98	20.8	-2.6	315.0	35.3	13	1350.0	151.4	15
CC444	04	RV	49016	13-Nov-98	20.3	-0.5	383.0	42.0	7	1310.0	143.5	-8
CC282	04	RV	49017	13-Nov-98	20.0	-0.3	354.0	38.2	-4	1390.0	149.9	6
CC484	04	RV	48865	13-Nov-98	24.9	4.9	317.0	42.6	4	1450.0	194.8	45
CC454	05	RV	48866	13-Nov-98	22.2	-2.7	715.0	85.5	43	1600.0	191.3	-3
CC455	05	RV	48867	13-Nov-98	25.8	3.6	550.0	76.5	-9	1760.0	244.8	54
CC17	05	RV	49019	14-Nov-98	19.2	-6.7	127.0	13.1	-63	2620.0	270.6	2
CC286	05	RV	49020	14-Nov-98	21.9	2.7	136.0	16.0	3	3500.0	412.6	14
CC457	05	RV	48870	14-Nov-98	25.2	3.3	117.0	15.9	-	4760.0	645.5	23.
CC288	05	RV	49001	14-Nov-98	22.5	-2.6	83.5	10.1	-6	4610.0	559.8	-86
CC392	03	SS	48860	12-Nov-98	0.3	-	27.5	<0.1	-	129.0	0.2	-
CC273	02	RV	168523	10-Nov-97	20.1	-	0.5	<0.1	-	9.8	1.1	-
CC274	02	RV	168477	10-Nov-97	17.8	-2.3	0.4	<0.1	-	20.3	1.9	1

Table 4.2-2 (Continued)
Mass Load Sampling Events

Location	CSM Segment	Sample Type	Sample ID	Sample Date	Flow (CFS)	Flow Delta	TOTAL LEAD Conc. (µg/L)	TOTAL LEAD Load (lbs/day)	TOTAL LEAD Delta[1] (lbs/day)	DISSOLVED ZINC Conc (µg/L)	DISSOLVED ZINC Load (lbs/day)	DISSOLVED ZINC Delta[1] (lbs/day)
CC276	04	RV	168478	10-Nov-97	20.1	2.3	2.8	0.3	0	39.3	4.3	2
CC277	04	RV	168479	10-Nov-97	23.2	3.1	4.8	0.6	0	119.0	14.9	11
CC278	04	RV	168480	10-Nov-97	28.2	5.0	7.4	1.1	1	351.0	53.4	38
CC279	04	RV	168481	10-Nov-97	25.5	-2.7	2.0	0.3	-1	477.0	65.6	12
CC280	04	RV	168482	10-Nov-97	22.2	-3.3	12.3	1.5	1	503.0	60.2	-5
CC281	04	RV	168483	10-Nov-97	42.3	20.1	30.3	6.9	5	664.0	151.4	91
CC282	04	RV	168484	09-Nov-97	34.7	-7.6	58.3	10.9	4	1140.0	213.2	62
CC283	05	RV	168485	09-Nov-97	32.8	-1.9	66.3	11.7	1	1220.0	215.7	2
CC284	05	RV	168486	09-Nov-97	35.0	2.2	70.7	13.3	2	1240.0	233.9	18
CC285	05	RV	168487	09-Nov-97	42.6	7.6	77.6	17.8	4	1480.0	339.8	106
CC286	05	RV	168488	09-Nov-97	31.9	-10.7	74.1	12.7	-5	2090.0	359.4	20
CC287	05	RV	168489	09-Nov-97	32.7	0.8	74.7	13.2	0	2610.0	460.0	101
CC288	05	RV	168490	09-Nov-97	36.6	3.9	77.5	15.3	2	2680.0	528.7	69

[1]: The Delta value reported at a sample location is the difference between mass load at that location and the next upstream sampling location, except for side streams and adits (sample types SS and AD, respectively), which are the mass load at that location.

- : No data or calculation not applicable
RV: River Sample
AD: Adit Sample
SS: Samples Collected in Side Stream off the Main Stream Channel
CFS: Cubic feet per Second
µg/L: Micrograms per liter
lbs/day: Pounds per day
Flow Delta: Is the increase or decrease in flow compared to the next upstream sampling station

5.0 FATE AND TRANSPORT

The fate and transport of metals in surface water, groundwater, and sediment in the Canyon Creek Watershed are discussed in this section. Initial findings on metals concentrations and mass loading for each segment, as presented above in Section 4, Nature and Extent, are briefly summarized in Section 5.1. A conceptual model of fate and transport is included in Section 5.2. Important fate and transport mechanisms are briefly summarized in Section 5.3. The probabilistic model developed to evaluate fate and transport is summarized in Section 5.4. Results of the model are presented in Section 5.5. Sediment transport is summarized in Section 5.6. A summary of fate and transport of metals in Canyon Creek is presented in Section 5.7.

5.1 INTRODUCTION

Canyon Creek contributes significant quantities of cadmium, lead, zinc, and other metals to the South Fork. The dissolved zinc and total lead loadings measured during six sampling events (May 1991; October 1991; November 1997; May 1998; November 1998, and May 1999) are listed in Table 4.2-2. Potential sources of these metals in the watershed were identified for each segment in Section 4.1 and preliminary mass loading estimates were discussed in Section 4.2. Brief summaries of those results are included in this section.

Segment CCSeg01 is the uppermost segment and is located above the Hecla water intake. The BLM identified 19 potential source areas in this segment but they do not appear to be heavy loaders to this segment nor to the upper boundary of Segment 2. Of seven samples analyzed from CCSeg01, the average total concentrations of zinc, lead, and cadmium were 14.6, 2.6, and 4 µg/L, respectively. None of these averages exceeded ambient water quality criteria nor did any of the maximum detected values.

Segment CCSeg02 encompasses Canyon Creek from the Hecla water intake to the mouth of Gorge Gulch. The BLM identified 13 potential sources in this segment, many in close proximity to the creek. Segment 2, however, apparently does not contribute significantly to Canyon Creek because of the relatively low metal concentrations measured in surface waters.

Segment CCSeg03 contains Gorge Gulch. The BLM identified 17 potential sources in this segment, including the Hercules complex. Sampling at the mouth of Gorge Gulch indicates metals concentrations above ambient water quality criteria. As discussed in Section 4.2, the metal loading is low compared to downstream segments; however, dissolved zinc loading was calculated as high as 21.5 pounds per day during the spring 1998 high flow event.

Segment CCSeg04 begins at the mouth of Gorge Gulch and ends south of Gem. The BLM identified 64 potential source areas in this segment. Concentrations of metals in surface water and sediment are correspondingly high. Metal concentrations in surface water routinely exceed ambient water quality criteria. Approximately 30 pounds of dissolved zinc have been measured entering Segment CCSeg04 under high-flow conditions.

Segment CCSeg05 is the lowest portion of the watershed and encompasses Woodland Park. The BLM identified 12 potential source areas in this segment, including the Hecla-Star tailings ponds. In this segment the valley widens into a broad depositional floodplain with up to 40 feet of alluvium overlying the bedrock in places. The near surface alluvial material is a potential source of metals to Canyon Creek. Metal concentrations in surface water routinely exceed ambient water quality criteria. Loading of dissolved zinc to Canyon Creek in this segment may increase by 200 to 700 pounds or more on a daily basis depending on the time of year and magnitude of the discharge event.

In general, in the upper part of Segment CCSeg05, where the creek widens into a depositional basin, surface water is lost to groundwater. Metal migration in groundwater occurs primarily in the dissolved form as the soil filters particulates. It is thought that groundwater interacts with floodplain sediments below the Hecla-Star tailing ponds and is augmented by precipitation and drainage water discharged to Pond No. 6. Sampling results indicate that contaminated sediments and soils remain in the floodplain. The impact of floodplain sediment removal on the lower portion of the creek has not been determined. Additionally, groundwater monitoring in the floodplain suggests that a plume of metals has formed in association with the new tailings repository. In the lower part of Segment 5, where the creek narrows before the confluence of Canyon Creek with the South Fork, groundwater re-enters the creek with metals, again, principally, in the dissolved phase.

5.2 CONCEPTUAL MODEL OF FATE AND TRANSPORT

A summary of the conceptual model for fate and transport of metals in surface water, groundwater, and sediment of the watershed is presented in this section. A detailed discussion is presented in Part 1, Section 3.3, Geochemistry.

Fate and transport of metals in air were not evaluated as part of this investigation. Inhalation of dust has been evaluated in previous risk assessments in the basin and was determined not to be a primary contributor to human health exposure and risk (Weston 1989). Additionally, transport of metals via the air pathway to surface water is considered insignificant compared with other known sources of metal transport to surface water, including soil and sediment erosion and groundwater transport.

Overland surface soil erosion, or mass wasting, from non-mining related areas was also not evaluated specifically in this investigation. Surface soil and surface water metals concentrations in areas with little to no mining-related activities tend to be much lower than surface soil and surface water metals concentrations in areas heavily impacted by mining-related activities (Stratus 1999). Contributions from this pathway are considered to be minimal; however, they are accounted for in the overall evaluation of surface water concentrations and mass loading in this section.

The primary sources of metals observed in surface water, groundwater, and sediment are waste piles and mixed tailings and alluvium located within the watershed. Metals are released primarily through oxidation of sulfides in the waste materials. In the oxidation process, metals (e.g., lead, zinc, and cadmium) are transformed from a highly immobile to a relatively mobile state. This transformation takes place as sulfides come into contact with water and the atmosphere, are oxidized, and are replaced by minerals and solid phases (e.g., oxides and sulfates) with greater potential mobility. The oxidation process itself may release hydrogen ions and lower the pH. Metals tend to be more soluble (and mobile) at lower pH values. Even at neutral pH values, however, high metal concentrations may be found.

After release, metals migrate in dissolved and suspended particulate forms in surface water. At least part of the particulate metal load occurs as metals adsorbed onto precipitated iron. Additionally, metals migrate as bedload material. Whereas finer particles are suspended in solution, metals migrating as part of the bedload are often associated with larger particle sizes (e.g., sand-sized and larger). Bedload particles can consist of mixtures of natural sediments, erosive soils, tailings, and fine waste rock and can skip or roll along the streambed.

Surface waters in the watershed discharge to groundwater and other surface water bodies (e.g., the South Fork). Metal migration in groundwater occurs primarily in the dissolved form as the soil filters particulates. Accordingly, metals are discharged from groundwater to surface water predominantly in the dissolved form.

Particulate metal loading is especially pronounced during the highest flow events. High-flow periods usually occur in the spring as a result of precipitation and snowmelt but can occur in midwinter for the same reasons. Upon entering Canyon Creek, dissolved and particulate metals are transported downstream. In general, where the creek widens into floodplains, there is a tendency for surface water to discharge dissolved metals to groundwater and deposit suspended sediment onto the streambed. Conversely, in areas where the river channel narrows, groundwater tends to discharge metals to the river system, again, principally in the dissolved phase.

As suspended or bedload sediments are transported by the river system, metals will tend to desorb from the sediments and enter the river in the dissolved phase. Furthermore, metals may enter the river from riverbank porewater. During high flow events, riverbanks and adjacent floodplain areas store water. The stored pore water can increase in concentration as metals desorb from sediments or as precipitated solid phases and minerals dissolve. As the waters subside, these dissolved metals reenter the river system and are transported.

Physical erosion of riverbanks and channels also causes particulate forms of metals to re-enter the river and be transported. There is a propensity for increased erosion or bank caving during high-flow events and following high-flow events when river banks are saturated and the river stage decreases. There is a propensity for sediment deposition as river stage decreases. Additionally, efflorescent salts are left behind from high flow events as the water slowly recedes by evaporation. These efflorescent or evaporite materials dissolve with subsequent high-flow events. A certain percentage of the particulate (suspended and bedload) and dissolved load of Canyon Creek discharges directly into the South Fork.

5.3 FATE AND TRANSPORT MECHANISMS

Building on the conceptual model presented above, this section includes general descriptions of the sources, release mechanisms, movement, and attenuation of metals within the Canyon Creek Watershed. Detailed descriptions of these processes were presented in Part 1, Section 3.3, Geochemistry. Primary geochemical reactions, including acid/base generation, dissolution/precipitation, adsorption/desorption, and oxidation/reduction reactions, are briefly described in this section. Primary transport mechanisms for surface water and sediment were presented above in Sections 2.3, Hydrology, and 3, Sediment Transport. These reactions and mechanisms are inter-related and control the movement of metals from source rock to and between surface water, groundwater, and sediment throughout the watershed.

5.3.1 Acid/Base Generation

Acid-generating minerals in the watershed (e.g., pyrite) result in acid pH values and the mobilization of metals into solution, whereas significant amounts of acid neutralizing minerals (e.g., calcite) increase the pH and can result in precipitation of metals from solution.

Acid or base generation occurs when minerals in the watershed come into contact with water and the atmosphere. For example, at least 138 adits and at least seven seeps from waste rock piles have been identified in the Canyon Creek Watershed (Stratus 1999; Gearheart et al. 1999). Measurements of the pH values of surface waters in the Canyon Creek Watershed vary from slightly acidic in seeps and adits (pH range of 3.4 to 6.2) to slightly alkaline at in-stream locations (pH range of 7.2 to 8.9) (Part 1, Figure 3.3-4). The majority of waters in Canyon Creek have near neutral pH values or are only slightly acidic. One reason for this is the wide spread presence of calcite, $CaCO_3$, the main base-generating mineral in the basin. Another reason for the predominantly near-neutral and slightly alkaline water in Canyon Creek is pyrrhotite. Pyrrhotite ($Fe_{1.0\text{-}x}S$), which has only a small capacity to produce acidity, dominates over pyrite (FeS_2) in Canyon Creek and, in combination with carbonates, helps minimize formation of acidic waters in this area.

Varying pH regimes can effect precipitation/dissolution of solid and mineral phases thereby affecting transport rates. Precipitation reactions may be particularly important at adits in Canyon Creek where low pH waters can be buffered to higher pH values. In surface waters of Canyon Creek, there is typically little change in the pH value and, consequently, limited precipitation from these waters. Additionally, for many metals, increased adsorption occurs at higher pH values. Adsorption of metals onto iron oxyhydroxides can go from zero percent adsorption to 100 percent adsorption over approximately 1-3 pH units. Changing pH values impact adsorption reactions through adsorption of metals onto precipitated solids; therefore, varying pH regimes causes metal adsorption to decrease or increase.

5.3.2 Adsorption Onto Iron Oxyhydroxides

Metals or species are removed from solution by physical entrapment, surface adsorption, or substitution into the crystal lattice. Iron is important because it can change the pH of water as it loses or gains electrons and precipitates or dissolves in the oxide or sulfide mineral state. Metals also adsorb/coprecipitate with iron, decreasing solution concentrations of dissolved metals. Further, given a change in the redox condition and/or pH, the iron may dissolve releasing metals into solution.

Whether ferrous (+2 oxidation state) iron in Canyon Creek is released from pyrite or pyrrhotite, upon exposure to oxygen, ferrous iron oxidizes to the +3 oxidation state, hydrolyzes, and precipitates as iron oxyhydroxide. These iron oxyhydroxides can be transported as colloidal material or coat other particles such as silts, sands, and clays. In either case, the iron material acts as an adsorbent for other metals.

Modeling to predict the adsorption of zinc, lead, and cadmium was conducted for two principal reasons: (1) to determine if the percentages of dissolved and particulate metals in solution could be explained by metal adsorption onto ferric oxyhydroxides, and (2) if metals appear to be primarily associated with iron oxyhydroxides in solution, to predict the optimal pH regime for stabilizing the metals (see Part 1, Section 3.3). Furthermore, if such a model is applicable, it may be possible to determine how iron releases or attenuates metals as the pH or solution composition change as metals associated with iron are transported throughout the basin.

A surface complexation model was used to predict metal partitioning between the dissolved and particulate phases of metals in Canyon Creek. Predictions obtained from the surface complexation model were compared to measured total and dissolved metals data. Surface complexation models can be used to accurately predict variations in oxide acid/base properties as a function of ionic strength and pH. This is especially important in locations like Canyon Creek where there is potential for significant pH changes as ores oxidize and produce acidity, which then becomes neutralized.

The MIT Diffuse-Layer Model (Dzombak 1986) was used to predict the partitioning of cadmium, lead, and zinc into dissolved and adsorbed phases for a given total concentration of each metal. The measured total concentration is equal to the suspended sediment fraction plus the dissolved fraction. Lead adsorption was predicted most accurately during high discharge events and zinc and cadmium were predicted most accurately during low-discharge events. In the high-discharge event, where more total iron and metals are resuspended, predicted adsorption percentages for lead were usually greater than 90 percent and were similar to measured total metal percentages. Predicted adsorption percentages for cadmium and zinc were not nearly as accurate as lead predictions, being sometimes higher and sometimes lower than the measured values. For example, in the May 1999 high-discharge event, the predicted percentage of adsorbed lead at the mouth of Canyon Creek (sampling location CC288) was 97.9 percent versus a measured value of 98.7 percent. The predicted and measured (in parentheses) percentages for cadmium and zinc were 6.6 percent (47.3 percent) and 36.6 percent (52.1 percent), respectively. For a low-discharge event, the predictions followed the measured lead adsorption trends and predicted minimal adsorption of zinc and cadmium. This prediction of minimal adsorption of zinc and cadmium was confirmed by the analytical data, where the majority of the metal was found in the dissolved phase.

5.3.3 Precipitation/Dissolution

Precipitation and dissolution of solid phases can be important mechanisms for release or immobilization of metals. Precipitation/dissolution reactions are expected to be particularly important where large gradients in pH, redox potential, or metal concentrations exist and may be important in Canyon Creek. Consequently, precipitation/dissolution reactions using solid phases and minerals expected to precipitate or dissolve rapidly enough to control the concentrations of certain of their elemental components (cadmium, lead, and zinc) were used to aid in understanding fate and transport.

Precipitation/dissolution reactions at the mouth of Canyon Creek were modeled using an ion speciation/solubility computer model (MINTEQA2) (Allison et al. 1991). Solubility calculations were performed to evaluate if a mineral was oversaturated, undersaturated, or at equilibrium with the solution. The existence of oversaturation conditions is usually explained by precipitation kinetics and/or mineralogical factors that prevent the solid from precipitating at a rate sufficient to control the concentrations of its dissolved components. If the saturation index reflects undersaturation, it is concluded that either (1) a less soluble (more thermodynamically stable) solid is controlling the dissolved constituents, concentrations, (2) another mechanism, such as adsorption, is controlling the concentrations of the component species below their solubility products, or (3) the constituents, concentrations in the source are low.

Computations of saturation indices in surface waters in Canyon Creek indicated undersaturation with respect to plausible solid-phase controls for zinc and cadmium in the May 1999 high-discharge event. Plausible solid-phase controls are solids that could be precipitating or dissolving rapidly enough to control the concentrations of certain of their dissolved components. The plausible solid-phase controls evaluated by the model included sulfates, carbonates, hydroxides, hydroxycarbonates, and phosphates. Lead was undersaturated with respect to the same possible solid-phase controls except for a lead phosphate. Using a phosphate concentration from another location in the basin, pyromorphite ($Pb_5(PO_4)_3Cl$) was oversaturated with respect to its dissolved components and could help maintain dissolved lead and phosphate concentrations at low levels.

In general, precipitation of mineralogical forms of cadmium, lead, and zinc is not expected to control the concentrations of these metals in surface waters of Canyon Creek during high-discharge events. Mineralogical forms of cadmium, lead, and zinc are, however, expected to dissolve and release metals to solution as surface waters migrate through reaches where efflorescent lead, zinc, and cadmium are present due to evaporative processes.

5.4 FATE AND TRANSPORT MODEL

Understanding the movement, or fate and transport, of metals from source areas to other parts of the basin is a key piece of both the remedial investigation (RI) and the feasibility study (FS). To understand a large natural system like the Coeur d'Alene River Basin, it is important to answer the what, where, and how questions of metal movement.

What is the best way to describe metal movement and deal with the large variation in the natural world and the data? A mathematical model, called a *probabilistic model*, was selected as the best tool to handle the analysis of the complex fate and transport mechanisms involved (see Section 5.3). For selected stream monitoring points in the basin (e.g., the mouth of Canyon Creek, Pinehurst, and Harrison), the model is used to:

- Predict metal concentrations in the stream
- Predict metal loading[1] in the stream (i.e., how much metal is flowing in the stream)
- Quantify the uncertainty associated with the predictions in a consistent and coherent manner

The portion of the model used for the RI is limited to current conditions in the basin. In the FS, the complete model is used to make quantitative estimates of the potential remedial performance associated with each remedial alternative. Because it helps quantify the certainty that a remedial action will actually result in meeting cleanup goals, the model can be used in the remedy selection process to help decision-makers select and prioritize cleanup efforts.

This section provides an introduction to the model as used in the RI for metal fate and transport. Metal fate and transport and natural variability are introduced first. This is followed by a discussion of the model with an emphasis on the lognormal distributions that are used in the

[1]Loading is the quantity of metal transported in stream flow (usually measured as pounds of metal per day, #/d). Loading is calculated by multiplying the stream flow (usually measured as cubic feet of flow per second, cfs) and the metal concentration in the stream flow (usually measured as parts per billion, ppb).

model. Model results for the RI are presented in Section 5 of Parts 2 through 6. Model development details will be presented in the forthcoming technical memorandum *Metal Mass Loading and Concentrations: Probabilistic Model Formulation* (URS 2000).

5.4.1 Metal Fate and Transport

The focus of metal fate and transport in the probabilistic model is the movement of metals by water, both surface water and groundwater. This section presents a simple overview of metal transport by water in the basin.

Metal transport in the basin is complex. Metal transport begins with the metal sources in the basin that have been created by historical mining activities. Scattered throughout the upper basin, primary metal sources include tailings and waste rock piles, tailings buried in river floodplains, and discharges from mine adits. Secondary sources include tailings-impacted river sediments in the upper basin and contaminated sediments in floodplains, wetlands, and lateral lakes of the lower basin. Throughout the basin, these sources vary dramatically in their size, metal concentrations, and degree to which they act as metal sources.

Transport by flowing water is the primary way that metals are moving in the basin. Metal transport begins when water contacts a metal source, and the metals become dissolved or suspended in the water. Water contacts metal sources in many ways. Examples include streams flowing over exposed sources in stream channels; groundwater flowing through buried sources (e.g., sources that are buried in river floodplains); and surface water runoff from rainfall and snowmelt that flows over or into waste piles.

The dissolution or suspension of metals into water occurs to varying extents, depending on geochemical, hydrologic, and geologic conditions. Also, under certain conditions, metals that are already dissolved or suspended in water can be removed from the water by natural physical, chemical, and biological processes. The quantity of metal in water that is available for transport depends on the net difference between the metals entering the water and the metals leaving the water. This net difference varies from location to location and over time, depending on the natural variability in the conditions that control the various processes. Metals that remain in surface water or groundwater are transported with that water.

As water flows downgradient from the higher areas of the basin, either as groundwater or surface water, it mixes with other waters. Mixing occurs both as different groundwater flows merge or seep into surface water, and as surface water steams combine into large streams. The degree of mixing and the quantities of water involved depend on geologic and hydrologic conditions that vary over time and location. Sooner or later, any water carrying metals will enter the major streams of the basin, and be further transported by stream flow down the basin.

5.4.1.1 Natural Variability

All these sources of natural variability in the basin, which include:

- Variability in metal sources
- Variability in the degrees to which metals enter and remain in water
- Variability in the quantities of flowing water
- Variability in the mixing processes that occur as waters flow downgradient

cause natural variability in the transport of metals in the basin. In particular, stream flows and the transported metal concentrations and loadings generally show great natural variability. This natural variability is dynamic. It occurs both by location along the stream and over time at any given stream location.

From the standpoint of predicting metal transport, natural variability is a fundamental consequence of imperfect knowledge about the natural system. It is the result of not having complete information on all the processes, conditions, factors, and parameters that determine actual stream flows and metal concentrations and loadings throughout the basin. Furthermore, complete information would include knowing how these determinants will change over time. Such complete knowledge is not attainable in any practical sense.

Natural variability creates uncertainty. Because of natural variability, stream flows and metal concentrations and loadings are always uncertain to some extent. Uncertainty due to natural variability can be minimized at any specific location and time by taking measurements of stream flows and metal concentrations and (computing) loads. However, as time passes, stream flow and metal concentration and loading at that point will change to an uncertain extent due to natural variability. Therefore, except at the time measurements are taken, stream flows and metal concentrations and loadings are uncertain.

Uncertainty due to natural variability makes *accurate* predictions of stream flows and metal concentrations and loadings impossible, except in a *probabilistic* sense, as discussed in the following section. Therefore, to deal with uncertainty due to natural variability, a probabilistic model is used to make predictions of stream flows and metal concentrations and loadings for the basin. The following section provides an overview of the model.

5.4.2 Probabilistic Model

As discussed above, motivation for using the probabilistic model stems from the inherent complexity and uncertainty associated with stream flows and metal concentrations and mass loadings in the basin. Probabilities, based on the mathematics and physics of "chance," are used to quantify natural variability and uncertainty.

The probabilistic model is based on the fact that effects of natural variability result in characteristic patterns that can be described, or *modeled*, and analyzed mathematically. Specifically, the natural variability in stream flows and transported metal concentrations and loadings follows a pattern called a *lognormal probability distribution* or, simply, a *lognormal distribution.* The lognormal distribution is a pattern commonly found in the natural world. The theoretical basis as to why stream flows and metal concentrations and loadings should follow lognormal distributions comes from the physics and mathematics of probability ("laws of chance") and random processes, including the Theory of Successive Random Dilutions, the Law of Proportional Effect, and the Central Limit Theorem.

Most important, lognormal distributions fit the available measurements of stream flows and metal concentrations and loadings in the basin. The fits are good approximations that reflect the fact that no theoretical distribution ever exactly fits real world data, which are of limited quantity and subject to measurement errors.

What gives the lognormal distributions practical value is their quantification of the accuracy of specific estimates or predictions of flow and metal concentrations and loadings within the basin. However, before discussing this, it may be helpful to make lognormal distributions a bit more concrete, which is the purpose of the following illustration and example.

5.4.2.1 Illustration of Lognormal Distributions

Figure 5.4-1 is an illustration depicting the repeated measurement over time of stream flows and metal concentrations and loadings at a sampling point. The sampling point is located downstream from various metal sources that load the stream system over a geographic region, which includes loadings to tributaries and groundwater. The idealized depiction in Figure 5.4-1 is meant to represent a realistic situation with multiple metal sources and water transport processes that naturally vary in response to the many conditions that determine stream flows and metal concentrations and loadings.

The situation in Figure 5.4-1 assumes a given sampling location where repeated measurements of stream flow and metal concentration (from which loading is computed) are made. The measurements would occur over a suitable period of time, say twice a month over several years. To be specific, assume that, over the sampling time period, a total of 100 measurements of stream flow and metal concentration are made. Because of natural variability, these 100 measurements will have a distribution of values, ranging from relatively low to relatively high. There will be a different distribution for flow, for metal concentration, and for metal loading.

To continue the illustration, take the flow measurements and imagine making a *histogram* of the results, as illustrated in Figure 5.4-1; that is:

- Divide the range of flow measurements into several groupings of increasing flow, from low values to high values
- Count the number of samples having flow results in each grouping
- Graph the number of samples in each grouping to make a histogram

Figure 5.4-1 shows a typical histogram for stream flows. The histogram follows a lognormal distribution. Relatively few flows occur in the first grouping, reflecting the observation that the very lowest flows are relatively uncommon. The most common flows occur in the second grouping, reflecting typical "low flow" (summer) conditions. The most common flows have the maximum[2] number of samples. After the maximum, the number of samples decreases with the increasing flow.

The number of samples "tails off" at the higher flows, to the right on the histogram. This characteristic is known as a "skew" in the higher-flow "tail" of the distribution, or simply "skew." A distribution with low skew is more symmetrical than one with high skew. The degree of skew indicates the degree of natural variability: more skew means more natural variability, and vice versa.

The curve superimposed over the histogram show the equivalent lognormal distribution that would result from a large number of measurements and using very narrow histogram groupings.

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[2]The maximum number of samples in the distribution should not be confused with "peak flow," which occurs during flood events. Peak flows would be represented in the tail of the flow distribution, in the far right of the histogram.

That is, very narrow histogram groupings and a very large number of measurements would result in a "continuous" distribution.

Histograms for the metal concentrations and metal loadings would also result in lognormal distributions, as illustrated in Figure 5.4-1. Note that all values are positive, since there can be no negative flows, concentrations, or loadings. The restriction to positive values and a skewing of higher values in the tail of the distributions are characteristic of lognormal distributions.

Figure 5.4-1 is an illustrative example based on hypothetical measurements. As will be discussed next, Figure 5.4-2 through 5.4-4 show lognormal results from actual, historical measurements of stream flows and metal concentrations and loading.

5.4.2.2 Example of Historical (Actual) Measurements

Historical measurements are important because they provide a database for predicting current and future values. Specifically, in the RI/FS, lognormal distributions are estimated from historical measurements of stream flow and metal concentrations and loadings using statistical methods based on linear regression. Results are presented in Sections 5 of Parts 2 through 6.

To help make these lognormal distributions more concrete, Figures 5.4-2 through 5.4-4 show the histograms from results of historical measurements at the USGS sampling station at Pinehurst (SF271) on the SFCDR. The historical measurements include stream flow (Figure 5.4-2), dissolved zinc concentrations (Figure 5.4-3), and dissolved zinc loadings (Figure 5.4-4). Approximately 100 measurements were taken periodically between 1991 and 1999.

Two sets of histograms are shown in Figures 5.4-2 through 5.4-4. The dark histograms are for the historical measurements. The open histograms are for the theoretical lognormal distributions that were estimated from the measurements using statistical techniques.

As can be seen, there is a very high correspondence between the measurement histograms and the lognormal histograms. The deviations that do occur mirror the fact that no theoretical distribution ever exactly fits real world data, which are always subject to limitations. In particular, the historical measurements, like all measurements, suffer from measurement errors. In addition, the limited number of available historical measurements subjects the lognormal distributions to a degree of statistical uncertainty. It is very likely that the correspondence between the measurements and the lognormal distribution would increase further, particularly in the skewed tails of the distribution, if additional measurements, taken with minimal error, were available.

Importantly, similarly high correspondence between historical measurements of flow and metal concentration and loading and lognormal distributions has been found at all other sampling stations. This consistently high degree of correspondence helps provide practical confirmation that the *true* values of current stream flow and metal concentration and loading can be adequately *modeled*, or approximated, as lognormal distributions. Nevertheless, like the historical measurements on which they are based, theoretical distributions are only approximations of future values, which are always inherently uncertain to some degree.

Figure 5.4-5 shows the estimated lognormal distribution for zinc loads using a histogram with 100 groupings (the skewed curve in the figure). Compared to the nine groupings used in Figures 5.4-2 through 5.4-4, these 100 groupings are narrow enough to indicate the equivalent "continuous" distribution. The continuous distribution is what the lognormal distribution predicts would result if a very large number of measurements (e.g., thousands) were made (and analyzed using the same 100 histogram groupings used in Figure 5.4-5).

The shape of the continuous distribution provides a "picture" of the natural variability. A wide or highly skewed distribution means high natural variability. A narrow or symmetric distribution means low natural variability. The continuous distribution reflects the net effect from all-upstream metal sources and fate and transport processes. In the case of Figure 5.4-5, the continuous distribution reflects that net effect for zinc loading in the SFCDR at Pinehurst.

5.4.2.2.1 Cumulative Probabilities. The cumulative probabilities are also graphed in Figure 5.4-5. For any given zinc load, the cumulative probability is the sum of the probabilities from all the histogram groupings less than or equal to the given load. Or simply, the cumulative probability is the sum of the probabilities of all loads less than or equal to a given load. The cumulative probabilities start at 0 percent for zero load and increase with increasing load to an asymptotic maximum of 100 percent at the highest zinc loads.

It is the cumulative probabilities that are the key to the model. The cumulative probability for a given load is interpreted as the estimated probability (or "chance) that the true load (at any given time or over time) is less than the given load. Equivalently, the cumulative probability is the probability that the given load exceeds the true load. One minus the cumulative probability is an estimate of the probability that the true load exceeds the given load. Cumulative probabilities for stream flow and zinc concentration would be interpreted in the same way. Figure 5.4-5 provides some specific examples of probabilistic estimates using cumulative probabilities.

The cumulative probabilities from Figure 5.4-5 can be used to estimate the zinc *loading* in the SFCDR at Pinehurst having a given probability (or chance) of *not being* exceeded at any given time or over time. Figure 5.4-5, shows, for example, an estimated:

- 25 percent probability that the true load is 1,700 pounds per day or less
- 50 percent probability that the true load is 2,400 pounds per day or less
- 90 percent probability that the true load is 4,900 pounds per day or less

Similar estimates could be made of the true zinc loading having a given probability (or chance) of *being* exceeded at any given time or over time.

The cumulative probabilities can also be used to estimate the *probability* (or chance) that a given zinc loading is *below* (or not exceeded by) the true loading, at any given time or over time. Figure 5.4-5 shows, for example, that a:

- 2,000 pounds-per-day load has a 36 percent probability of not being exceeded
- 3,000 pounds-per-day load has a 65 percent probability of not being exceeded
- 7,000 pounds-per-day load has an 97 percent probability of not being exceeded

In addition, the cumulative probabilities can be used to estimate the probability (or chance) that any given zinc loading is *above* (or exceeded by) the true loading, at any given time or over time. Figure 5.4-5, shows, for example, that a:

- 10,000 pounds-per-day load has a 1 percent probability of being exceeded
- 5,000 pounds-per-day load has a 9 percent probability of being exceeded
- 1,000 pounds-per-day load has an 95 percent probability of being exceeded

Similar estimates for stream flow and concentrations could be made from the cumulative probabilities for those variables.

5.4.2.3 Use of the Lognormal Distributions

To help control data limitations, only those sampling stations having a reasonably adequate number of measurements are modeled probabilistically. For those stations, statistical methods are used to fit lognormal distributions to the available historical measurements of stream flow and metal concentrations and loadings. The resulting lognormal distributions represent estimates of current conditions, based on available data. At each sampling station, the lognormal distributions quantify:

- The natural variability associated with stream flow and metal concentrations and loading
- The net effect from all upstream metal sources and fate and transport processes, which result in the metal concentrations and loadings at the sampling location
- The metal concentration or loading having a given probability of not being (or being) exceeded by the true value
- The probability that any specific concentration or loading is higher or lower than the true value

It is in the FS and subsequent remedy selection that the model will be most useful. For the FS, the model is used to make quantitative estimates of each alternative's potential remedial performance. For each remedial alternative, the potential *post-remediation* metal concentrations and loadings are estimated for key stream monitoring locations in the basin. These estimates are compared to ambient water quality criteria (AWQC) and total maximum daily loads (TMDLs) and evaluated as part of the CERCLA remedial action evaluation criteria. The model is thus vital to helping evaluate the effectiveness of potential cleanup remedies.

The model can also be used in remedy selection. Because it helps quantify the certainty that a remedial action will actually result in meeting cleanup goals such as AWQC and TMDLs, the model can help decision-makers select a remedy. In addition, the model provides a risk management tool for making remedial decisions under conditions of uncertainty that can be used to estimate the confidence associated with those decisions.

5.5 MODEL RESULTS

Results from the probabilistic model are presented for cadmium, lead, and zinc in this section. Modeling results for estimates of discharge are discussed in Section 5.5.1. Modeling results for estimates of concentrations and mass loading of zinc, lead, and cadmium are discussed in Sections 5.5.2 through 5.5.4. Data and associated calculations are included in Appendix C.

Data were evaluated for seven separate sampling locations. Data for sampling locations CC287 and CC288 were combined and analyzed together due to their close proximity and the limited data for sampling location CC288. Expected values for discharge, metal concentrations, and mass loading were calculated. Results are summarized in Table 5.5-1 for discharge, dissolved cadmium and zinc and total lead concentrations and mass loading.

Only sampling locations with 10 or more individual data points for each parameter of interest were evaluated. In Canyon Creek the nine sampling locations, in order from upstream to the mouth, are CC2, CC276, CC278, CC291, CC282, CC284, CC285, CC287, and CC288. Sampling locations are shown in Figure 5.5-1.

The first sampling location, CC2, is located approximately one-half mile upstream from Burke. Data were evaluated only for zinc and lead because cadmium was not detected at this location (CC2). Sampling location CC276 is located immediately downstream of Burke while CC278 is situated near Mace. Sampling location CC291 is intermediate between the towns of Burke and Gem (CC282 is near Gem). Sampling locations CC284, CC285, and CC287 are, approximately, situated near the beginning, the middle, and the end of Woodland Park, respectively. The sampling location CC288 is at the confluence of Canyon Creek and the South Fork. River stretches bracketed by sampling locations are designated as "reaches."

5.5.1 Estimated Discharge

An example of the lognormal distribution of discharge data at sampling location CC287/288 is shown in Figure 5.5-2. Data from sampling location CC287/288 are used throughout this discussion for consistency of presentation and, additionally, because CC287/288 is located at the mouth of Canyon Creek. In Figure 5.5-2, the discharge (in cfs) is plotted on a log are scale versus the normal standard variate. The normal standard variate is equivalent to the standard deviation for a normalized variable. When the log of a variable (e.g., discharge) is plotted versus the standard normal variate, a straight line will result if the data are lognormally distributed. The probability distribution function shown in Figure 5.5-2 is a predictive tool that can be used to estimate the expected discharge and provide a quantitative estimate of the probability that the true discharge will not exceed a given value. The cumulative distribution function gives the probability that the observed discharge at any given time will not be exceeded by the estimated discharge at that cumulative probability. The cumulative distribution function is plotted versus the normal standard variate in Figure 5.5-3. To determine the probability of occurrence of a specific discharge, first select the discharge of interest of Figure 5.5.2, then find its corresponding normal standard variate. Using that value for the normal standard variate, look up its corresponding cumulative probability in Figure 5.5-3. For example, for a discharge of 100 cfs, the normal standard variate is approximately 1.5 (Figure 5.5-2). Looking on Figure 5.5-3, this value corresponds to a cumulative probability of approximately 0.93; therefore, approximately 93 percent of the time, discharges at this location will be 100 cfs or less.

As shown in Figure 5.5-2, there is a good fit of the lognormal regression line (solid line in Figure 5.5-2) to the data. This goodness of fit (as evidenced by a high coefficient of determination ($r^2 = 0.92$) supports the assumption that discharges are lognormally distributed. The dotted line represents the true (ideal) lognormal distribution having the same mean (41) and coefficient of variation (0.92) as the actual data. The expected value, or average discharge rate, for Canyon Creek at location CC287/288, is 53.4 cfs. Expected values for discharge at all eight sampling locations are summarized in Table 5.5-1.

Estimated gains or losses in discharge (EV) and the coefficients of variation (CV) for reaches on Canyon Creek are listed in Table 5.5-2. It should be kept in mind that the estimated expected values (average) of discharge, concentrations, or loads are not instantaneous values. On the contrary, they are long-term averages over a number of years.

The estimated discharges decrease in two reaches (between sampling locations CC282 and CC284; and CC285 and CC287/288). Within the certainty of the data, expected discharges between CC2 and CC276 are essentially equivalent. Discharges increase in the remaining reaches.

Surface water discharges to groundwater in the lower Woodland Park area (between CC285 and CC287/288) and in the upper Woodland Park area (between CC282 and CC284). The seepage study conducted by the USGS (Barton 2000) indicated surface water discharges to groundwater in these sections of Canyon Creek. Surface water losses to groundwater account for the decreased discharges observed in these reaches. Discharges to groundwater (losing reaches) occur in Woodland Park where the valley broadens and alluvial floodplains occur. Gaining reaches between sampling locations are caused by surface water runoff, direct precipitation, tributary streams, and groundwater recharge.

5.5.2 Estimated Zinc Concentrations and Mass Loading

Concentrations and loads for dissolved zinc, total lead, and dissolved cadmium were evaluated using the probabilistic model at the nine sampling locations (eight reaches) that contained a minimum of ten data points. Results of these analyses are provided in Appendix C. Data from the nine individual sampling locations are discussed below.

As examples of the lognormal distribution of metals concentrations, dissolved zinc concentrations and loading at sampling location CC287/288 are shown in Figures 5.5-4 and 5.5-5. The data follow a lognormal distribution as indicated by the high r-squared values for the dissolved zinc concentrations (0.95) and dissolved zinc loads (0.98).

The probabilistic lognormal distributions permit one to predict expected or average water concentrations at given points in a stream. Further, use of the distributions can be used to estimate how much material is in the stream (loading) at a given point and present the uncertainty associated with the predictions in a consistent and coherent manner.

To assist in interpreting and placing the results in context, screening levels, expected values (EV), and TMDLs are shown on the figures. The dissolved zinc screening level for surface water is 42 μg/L. The TMDL is given at 100 times the 10th, 50th, and 90th percentiles as presented in EPA's Technical Support Document (USEPA 2000). The screening levels and TMDLs were multiplied by scalars because the expected values are so much higher than the unscaled screening levels and TMDLs that they (screening levels and TMDLs) would not appear on the figures without scaling.

As shown in Figure 5.5-4, all dissolved zinc concentrations measured at sampling location CC287/288 are greater than 10 times the screening level, with approximately half the data points exceeding 100 times the screening level. The expected dissolved zinc concentration (EV) is approximately 57 times the screening level.

As inferred from Figure 5.5-5, all calculated dissolved zinc mass loading values at location CC287/288 are greater than 10 times the 50th percentile TMDL.

Figures similar to Figures 5.5-4 and 5.5-5 were generated for each of the nine sampling locations for zinc, lead, and cadmium. The results of these and additional analyses are included in Appendix C. Data in Appendix C were used to compute the expected values and coefficients of variation for dissolved and zinc concentrations and loads in the eight reaches of Canyon Creek. Estimated values for dissolved zinc concentrations and mass loading are summarized in Table 5.5-1. Estimated gains or losses in zinc concentrations and loads, and their coefficients of variation, for reaches on Canyon Creek are listed in Table 5.5-3.

The expected values of dissolved zinc concentrations and loads generally increase in the downstream direction on Canyon Creek. Exceptions to the general pattern of increasing concentrations and loads do occur, however, and are discussed reach by reach below.

5.5.2.1 CCSeg01 through CCSeg03

Limited sampling took place in CCSeg01 through CCSeg03, indicating that surface waters in these segments were not thought to contribute significant quantities of metals to Canyon Creek. Although more potential sources in CCSeg02 lie in close proximity to Canyon Creek than in

CCSeg01, the expected surface water concentrations of metals are relatively low. Furthermore, the discharge is relatively low (Table 5.5-1).

CCSeg03 encompasses Gorge Gulch. CCSeg03 has a number of potential sources including the Hercules Complex, Ajax No.2, and Trade Dollar Mine. Dissolved metal concentrations at the mouth of Gorge Gulch at times exceed screening levels, particularly in the spring. The mouth of Gorge Gulch enters Canyon Creek near the beginning of CCSeg04.

One sampling location (CC2) was evaluated in CCSeg02. This sampling location was located at the lower portion (upstream of Burke) of CCSeg02. Concentrations, discharges and loads at this sampling location are considered to define these parameters for CCSeg01 and CCSeg02. CCSeg03 contributes to the reach bracketed by sampling locations CC2 and CC276 (CCSeg04) through Gorge Gulch whose mouth lies within this reach. (Insufficient sampling (minimum of 10 data points) was performed at specific locations within CCSeg01 and CCSeg03 to satisfy the criteria for the probabilistic analysis. Therefore, the probabilistic analysis was not done for these segments.)

Sampling location CC2 is situated near the Gertie Mine. The estimated dissolved zinc concentrations arriving at sampling location CC2 are approximately 26 μg/L while the expected zinc load at this sampling location is approximately 2 pounds/day. The estimated value of 26 μg/L is lower than the screening level of 42 μg/L. The estimated value of the load arriving at sampling location CC2 (2 pounds) is approximately 0.36 percent of the estimated value of the load reaching the mouth of Canyon Creek and is lower than the dissolved zinc loading capacity established in the TMDL document (3.79 pounds/day at the 10th percentile) (USEPA 2000).

Therefore, the fact that a sufficiently large data set was not available in CCSeg01, CCSeg03, and the upper part of CCSeg02 to justify a probabilistic analysis appears relatively inconsequential. In fact, the paucity of data at locations within CCSeg01, CCSeg02, and CCSeg03 is a direct result of the relatively low contributions to loading within these segments. In summary, the data set used in the probabilistic analysis leaves only approximately 0.3 percent of the expected load from Canyon Creek that is not allocated to a specific reach.

Dissolved zinc loading increases by approximately 6 pounds per day between CC2 (CCSeg02) and CC276 (CCSeg04). Possible contributors to this increased loading include the Gertie Mine, Gorge Gulch, the impacted floodplain, Hercules No. 5, and the Tiger Poorman Mine. The increase between CC2 and CC276 was approximately 3 times the load arriving at CC2, indicating that reaches upstream of CC2 constitute a small portion of the load, and excluding these reaches from the probabilistic analysis will have little consequence.

5.5.2.2 CCSeg04

Four of the nine sampling locations from which data were analyzed lie within CCSeg04 (CC276, CC278, CC291, and CC282). The dissolved zinc load between sampling locations CC276 and CC278 increases by approximately 26 pounds/day. Based on the model, it is expected that approximately 97 percent of the zinc will be in the dissolved form at the downstream sampling location (CC278) within this reach. The estimated dissolved zinc concentration (122.4 µg/L) at CC276 is higher than the screening level for dissolved zinc in surface water (42 µg/L). The Hecla-Star Mine and Millsite Complex, and Hidden Treasure Mine among others, are potential sources that could contribute to the increased loading within this reach of CCSeg04.

The expected load increases by approximately 40.7 pounds/day between CC278 and CC291. The Standard-Mammoth Campbell complex and adit are found in this reach. Nearly all of the zinc is expected to be in the dissolved form (Appendix C).

The third largest increase in dissolved load (approximately 164 pounds/day) occurs between CC291 and CC282. Again, modeling indicates that dissolved zinc (approximately 97 percent of total load) is predominant. The increased loading in this reach correlates well with the increased number of potential sources. Examples of potential sources are the Frisco Complex, the Black Bear Complex, and the Gem Complex.

The next downgradient sampling location is CC284 (CCSeg05). Based on evaluation of CCSeg04 and CC284, the expected gain in the dissolved zinc load in CCSeg04 is approximately 220 pounds/day.

5.5.2.3 CCSeg05

CCSeg05 is the lower part of Canyon Creek and includes Woodland Park. The valley widens here into a broad depositional floodplain with up to 40 feet of alluvium overlying bedrock.

The only decrease in the expected dissolved zinc loads as one progresses downstream in Canyon Creek occurs between sampling locations CC282 and CC284, in the upper part of CCSeg05. The expected dissolved zinc load is predicted to decrease in this reach by approximately 11.6 pounds/day. It is well established that in the upper region of CCSeg05, surface water is lost to groundwater as the valley broadens into a depositional basin. The expected or predicted loss in discharge in this reach is approximately 13 cfs (Table 5.5-2). Even though the load at CC284 (227 pounds/day) decreases in this reach (because of discharge to groundwater), significant loading is occurring based on the expected increase in zinc concentrations. Potential metal sources in this reach include the Canyon Creek floodplain, West Bell Mine, Gem Mill Site and Gem No. 3.

In the reach between CC284 and CC285, the second largest expected increase in dissolved zinc loading (approximately 173 pounds/day) occurred within the eight reaches of Canyon Creek analyzed. The modeling predicts that a large percentage (approximately 93 percent based on analysis of CC285) of the total zinc will reside in the dissolved form. However, the percentage of dissolved zinc is lower than found in upstream reaches. This occurs because of the higher discharge rates, which tend to suspend more particulates. More particulates result in more adsorption surfaces which bind with the zinc. More adsorption surfaces and binding with zinc results in more zinc in particulate form (adsorbed) at the highest discharge rates.

The expected discharge increases by approximately 37 cfs in this reach. The number of potential sources within CCSeg05 are fewer than in CCSeg04 but three sources contained within this reach, the Hecla-Star tailings ponds, the SVNRT tailings repository, and impacted floodplain, are, in aggregate, a very large source. It is believed that groundwater interacts with floodplain tailings deposits under the Hecla-Star tailings ponds, the repository, and the floodplain sediments, and is subsequently discharged to the creek.

The largest estimated increase in dissolved zinc concentrations (1,533 µg/L) occurs in the reach bracketed by sampling locations CC285 and CC287/288. The estimated dissolved zinc load does not increase commensurately with the expected dissolved concentration (dissolved load increased by approximately 156 pounds/day) because of an expected decrease in discharge of approximately 23 cfs. Surface water is lost to groundwater in this reach because the valley widens into a broad depositional basin. Essentially, all the estimated zinc load continues to exist as dissolved zinc.

Only at the highest discharge rates will the adsorbed or particulate zinc concentration or load approach 50 percent of the total zinc concentration or load. For example, at the mouth of Canyon Creek (sampling location CC288) during the May 1999 high-discharge event, the particulate zinc concentration was 53 percent of the total zinc concentration. Adsorption modeling indicated that increased pH values (> 1 pH unit) or increased ratios of adsorption sites/zinc would be necessary to significantly increase the particulate load at the expense of the dissolved load. Even though the particulate zinc load may increase under exceptionally high discharges, the model predicts (and data concur) that the dissolved zinc load typically should constitute over 90 percent of the total zinc load at the mouth of Canyon Creek. That is, dissolved zinc should dominate zinc loading over most of the year.

Estimated dissolved zinc concentrations at the mouth of Canyon Creek (CC287/288) are approximately 2,996 μg/L, which is considerably higher (approximately 70 times higher) than the established screening level (42 μg/L) for dissolved zinc in surface waters.

The estimated increase in dissolved zinc loading contributed by CCSeg05 is approximately 330 pounds/day. The estimated dissolved zinc load at the mouth (CC287/288) of the creek is approximately 556 pounds/day. This value is more than 20 times the 90th percentile total zinc load established at CC288 by the TMDLs (25.9 pounds/day).

5.5.2.4 Concentration Versus Discharge

Figure 5.5-6 is a log-log regression plot of the dissolved zinc concentration versus discharge at sampling location CC287/288. There is a general decrease in zinc concentrations with increased discharge which is significant at $\alpha = < 0.0001$ (α is the probability the correlation is due to chance). (In statistics, alpha [a] gives the probability of making a Type I error. A Type I error is that the theory is not true [the null hypothesis is true] but the results are significant by chance. In our case, alphas greater than 0.05 indicate that the result is not significant, that is, the correlation is due to chance [a 5 percent chance with our stated alpha level]. Alphas greater than 0.05 indicate, therefore, that the slope of the regression line is not significantly different from zero.) As one would expect, given that the majority of the zinc is in the dissolved phase, there is also a decrease in total zinc concentrations with increased discharge rates ($\alpha = < 0.0001$, plot not shown). The regression shown as Figure 5.5-6 permits estimation of the dissolved zinc concentrations at various discharge rates. Similar regressions were developed at the other sampling locations and metals (lead and cadmium). At all eight sampling locations there was a general decrease in dissolved zinc concentrations with increasing discharge rates (Appendix C).

Ion speciation solubility calculations with the MINTEQA2 geochemical computer code indicated there were no solid phases controlling zinc concentrations in surface waters in the Coeur d'Alene basin and at the mouth of Canyon Creek. Decreasing zinc concentrations with increased discharge rates supports this hypothesis by indicating that no solid is dissolving rapidly enough to achieve equilibrium with these surface waters. Otherwise, the concentrations would remain relatively constant at different discharge rates. As indicated in the solubility and adsorption modeling, adsorption is the most likely control on zinc concentrations. Accordingly, mechanistic modeling supports conclusions inferred from the regression analyses.

5.5.3 Estimated Lead Concentrations and Mass Loading

Total concentrations and loads for lead were evaluated using the probabilistic model at the eight sampling locations (seven reaches) that contained a minimum of ten data points. Data from the eight individual sampling locations are discussed below.

As examples of the lognormal distributions of metals concentrations, total lead concentrations and loads at the combined sampling locations CC287/288 are shown in Figures 5.5-7 and 5.5-8, respectively. The data follow a lognormal distribution as indicated by the r-squared values ($r^2 = 0.71$ and 0.91, respectively).

To assist in interpreting and placing the results in context, screening levels, expected values (EV), and TMDLs are shown on the figures. The screening level and expected values for total lead concentrations are shown on Figure 5.5-7. For total lead loads, the expected value and the TMDLs at 100 times the 10th, 50th, and 90th percentiles are shown on Figure 5.5-8. It was necessary to multiply the TMDLs by a scalar to place them on the graph because the measured values are significantly higher than the TMDLs. TMDLs used were those presented in the Final Technical Support Document of August 2000 (USEPA 2000). For total lead, the TMDL for the dissolved load was multiplied by a translator to convert to total lead load. As mentioned, the translator is the ratio of total lead to dissolved lead.

As shown in Figure 5.5-7, all total lead concentrations measured at sampling location CC287/288 are greater than the screening level, with approximately one-third of the data points exceeding times the screening level. The expected total lead load (48.6 pounds/day) is approximately 100 times the 90th percentile TMDL (Figure 5.5-8).

Figures similar to Figures 5.5-7 and 5.5-8 were generated for each of the eight sampling locations. The results of these and additional analyses are presented in Appendix C. Data in Appendix C were used to compute the estimated expected values and coefficients of variation for total lead concentrations and loads in Canyon Creek. Expected values for total lead concentrations and mass loading are summarized in Table 5.5-1. Estimated gains or losses in lead concentrations and loads, and their coefficients of variation for reaches in Canyon Creek are listed in Table 5.5-4. The calculations were performed in the same manner as described in the discharge section (Section 5.5.1).

The expected values of total lead concentrations and loads generally increase in the downstream direction on Canyon Creek. Exceptions to the general pattern of increasing lead concentrations and loads do occur, however, and are discussed reach by reach within the segments.

5.5.3.1 CCSeg01 through CCSeg03

Sampling locations analyzed within these segments were discussed above in Section 5.5.2.1.

Sampling location CC2 is situated near the Gertie Mine. The estimated total lead concentration at CC2 is approximately 3.2 µg/L while the expected total lead load at this sampling location is approximately 0.43 pounds/day. The screening level for total lead in surface waters is 15 µg/L, which is greater than the estimated total lead concentration (3.2 µg/L) at CC2.

The estimated value of the total lead load arriving at sampling location CC2 (0.43 pounds) is approximately 0.88 percent of the expected load reaching the mouth of Canyon Creek. Therefore, the fact that a sufficiently large data set was not available in CCSeg01, CCSeg03, and the upper part of CCSeg02 to justify a probabilistic analysis has minimal impact. In summary, the data set used in the probabilistic analysis leaves only 0.88 percent of the total expected lead load from Canyon Creek that is not allocated to a specific reach.

The estimated total lead loading increased by approximately 0.8 pounds/day between CC2 (CCSeg02) and CC276 (CCSeg04). Possible contributors to this increased loading include the Gertie Mine, Gorge Gulch, the impacted floodplain, Hercules No. 5, and the Tiger Poorman Mine. The increase between CC2 and CC276 was approximately 1.8 times the load arriving at CC2, indicating that reaches upstream of CC2 constitute a small portion of the total lead load.

5.5.3.2 CCSeg04

Four of the nine sampling locations from which data were analyzed lie within CCSeg04 (CC276, CC278, CC291, and CC282). The total lead load between sampling locations CC276 and CC278 increases by 0.3 pounds/day which is approximately 70 percent of the load arriving at CC276 from CCSeg01 through CCSeg03. Based on the model, it is expected that 53 percent of the lead will be in the particulate form at the downstream sampling location (CC278) within this reach. The Hecla-Star Mine and Millsite Complex, and Hidden Treasure Mine are potential sources that could contribute to the increased loading within this reach of CCSeg04.

The expected load increases by approximately 1.5 pounds/day between CC278 and CC291. The Standard-Mammoth Campbell complex and adit are found in this reach. Approximately one-half of the lead is expected to be in the particulate form. The estimated total lead concentrations (approximately 20.4 µg/L) first exceed the surface water screening levels (15 µg/L) for total lead concentrations at CC291. Thereafter, the total concentrations are higher than the screening levels at all sampling locations downstream.

The second largest loading increase (approximately 37 pound/day) occurred between CC291 and CC282. The increased loading in this reach correlates well with the increased number of potential sources. Examples of potential sources are the Frisco Complex, the Black Bear Complex, and the Gem Complex. The estimated expected gain in the total lead load in CCSeg04 is approximately 39 pounds/day.

5.5.3.3 CCSeg05

CCSeg05 is the lower part of Canyon Creek and includes Woodland Park. The valley widens here into a broad depositional floodplain with up to 40 feet of alluvium overlying bedrock in places.

The only decreases in estimated total loads as one progresses reach by reach downstream occurred between sampling locations CC282 and CC284 and between sampling locations CC285 and CC287/288. Sampling locations CC282 and CC284 lie in the upper region of CCSeg05. The estimated load is predicted to decrease in this reach (between CC282 and CC284 by approximately 27 pounds/day). In the upper region of CCSeg05, surface water is lost to groundwater as the valley broadens into a depositional basin (Barton 2000). Estimated total lead concentrations in this same reach decrease by 41.4 μg/L. The estimated or predicted loss in discharge in this reach was approximately 13 cfs (Table 5.5-2). Decreases in total lead concentrations and discharges in this reach contribute to the expected decrease in loading.

Potential metal sources in this reach include the Canyon Creek floodplain, Gem Mill Site and Gem No. 3.

The largest estimated increase (approximately 85 pounds/day) in total lead load occurred in the reach defined by CC284 and CC285. Approximately 84 percent of the lead in this reach is estimated to reside in the particulate form (based on sampling location CC285). The expected discharge increased by approximately 37 cfs in this reach. The number of potential sources within CCSeg05 are fewer than in CCSeg04 but the sources contained within this reach, the Hecla-Star tailings ponds, SVNRT repository, and the impacted floodplain are, in aggregate, a very large source. It is believed that groundwater interacts with floodplain tailings deposits under the Hecla-Star tailings ponds, the repository, and the floodplain and is subsequently discharged to the creek.

The largest estimated decrease in the total lead load (approximately 67 pounds/day) occurred in the reach bracketed by sampling locations CC285 and CC287/288. The estimated total lead load decreased commensurately with expected total concentration decreases of approximately

39 μg/L. The expected discharge decreased by approximately 23 cfs. Surface water is lost to groundwater in this reach because of the widening of the valley and the resulting broad depositional basin. Losses in discharge and decreased total lead concentrations result in a decrease in the total lead load in this reach.

Particulate lead at the mouth of Canyon Creek (CC287/288) is expected to comprise approximately 75 percent of the total lead. The percentage of lead in the particulate form increased with the increase in discharge. Higher discharges result in higher concentrations of suspended sediments and particulate lead because of the association of lead with particulates (especially metal oxyhydroxides). The expected percentage of particulate lead is consistent with the predictions obtained from the adsorption modeling.

The estimated total lead concentration at the mouth of the creek is approximately 174 μg/L. The estimated value exceeds the screening level in surface waters for total lead concentrations (15 μg/L). The estimated total lead loading at CC287/288 is approximately 48.6 pounds/day. The estimated expected value for total lead loading exceeds the 90th percentile TMDL for total lead (0.6 pounds/day) by approximately 80 times.

5.5.3.4 Concentrations Versus Discharge

Figure 5.5-9 is a regression plot, on a log-log scale, of the total lead concentration versus discharge at sampling location CC287/288. In contrast with zinc, there is an increase in total lead concentrations as discharge rates increase. However, there is a moderate probability ($\alpha = 0.11$) that this decrease is due to chance (α is the probability the correlation is due to chance). Similar regressions were developed at other sampling locations. At five of the eight sampling locations examined, a log-log plot of the total concentration versus discharge resulted in a line with a negative slope indicating decreasing lead concentrations with increasing discharge (Appendix C).

5.5.4 Estimated Cadmium Concentrations and Mass Loading

Dissolved cadmium concentrations and loads were evaluated using the probabilistic model at the eight sampling locations that contained a minimum of ten data points. Data from the individual sampling locations are discussed below.

As examples of the lognormal distribution of metals concentrations, dissolved cadmium concentrations and loading at the combined sampling location CC287/288 are shown in Figures 5.5-11 and 5.5-12. As with zinc and lead, there are high r-squared values for the dissolved cadmium concentrations (0.93) and dissolved cadmium loads (0.78), indicating a lognormal distribution.

To assist in interpreting and placing the results in context, the screening level, expected value (EV), and TMDLs are shown on the figures. The screening level (0.38 µg/L) and expected value (21.9) are shown on Figure 5.5-11. The TMDLs are provided on Figure 5.5-12 at 100 times the 10th, 50th, and 90th percentiles. All cadmium concentration data collected at sampling location CC287/288 are greater than the screening level with approximately three-fourths of the data points exceeding 10 times the screening level. All the calculated mass loading data exceed the 90th percentile TMDL (0.297 pounds/day) for the dissolved cadmium load.

Figures similar to Figures 5.5-11 and 5.5-12 were generated for each of the sampling locations. The results of these and additional analyses are presented in Appendix C. Data presented in Appendix C were used to compute the expected values and coefficients of variation for dissolved cadmium concentrations and loads in the seven reaches of Canyon Creek. Expected values for dissolved cadmium concentrations and mass loading are summarized in Table 5.5-1. Estimated gains or losses in cadmium concentrations and loads, and their coefficients of variation for reaches in Canyon Creek are listed in Table 5.5-5.

The expected values of dissolved cadmium concentrations and loads generally increase as we progress downstream on Canyon Creek. Exceptions to the general pattern of increasing cadmium concentrations and loads do occur, however, and are discussed reach by reach within the segments.

5.5.4.1 CCSeg01 through CCSeg03

Sampling locations analyzed within these segments were described above in Section 5.5.2.1.

Cadmium was not detected in samples collected from sampling location CC2. Sampling location CC276 is located near the beginning of CCSeg04. The mouth of Gorge Gulch, which drains CCSeg03, is also near the beginning of CCSeg04. The total expected cadmium loading to sampling location CC276 from upstream locations in CCSeg01 through CCSeg03 is 0.1 pounds/day (Appendix C). Accordingly, the expected load arriving at sampling location CC276 is approximately 2 percent of the expected total load arriving at the mouth of Canyon Creek. Therefore, the fact that a sufficiently large data set was not available in CCSeg01 through CCSeg03 to meet criteria of the probabilistic model appears relatively inconsequential. In summary, the data set used in the probabilistic analysis appears adequate and leaves only 2 percent of the expected load from Canyon Creek that is not allocated to a reach.

5.5.4.2 CCSeg04

Four of the eight sampling locations from which data were analyzed lie within CCSeg04 (CC276, CC278, CC291, and CC282). The total cadmium load between sampling locations CC276 and CC278 increases by 0.1 pounds/day, which is equal to the expected load arriving at CC276 from CCSeg01 through CCSeg03. Based on the model, it is expected that essentially all the cadmium will be in the dissolved form at the downstream sampling location (CC278) within this reach. The Hecla-Star Mine and Millsite Complex, and Hidden Treasure Mine, among others, are potential sources that could contribute to the increased loading within this reach of CCSeg04.

The expected dissolved load increases by 0.3 pounds/day between CC278 and CC291. The Standard-Mammoth Campbell complex and adit are found in this reach. Nearly all of the cadmium is expected to be in the dissolved form.

Dissolved cadmium loading increases by 1 pound/day between sampling locations CC291 and CC282. The increased loading in this reach correlates well with the increased number of potential sources. Examples of potential sources are the Frisco Complex, the Black Bear Complex, and the Gem Complex.

The next downgradient sampling location is CC284 (CCSeg05). Based on evaluation of CCSeg04 and CC284, the expected gain in the dissolved cadmium load in CCSeg04 is approximately 1.4 pounds/day.

5.5.4.3 CCSeg05

CCSeg05 is the lower part of Canyon Creek and includes Woodland Park. The valley widens here into a broad depositional floodplain with up to 40 feet of alluvium overlying bedrock in places.

The only decrease in the expected load as one progresses reach by reach downstream in Canyon Creek occurs between sampling locations CC282 and CC284, in the upper region of CCSeg05. The total expected cadmium load is predicted to decrease in this reach by 0.1 pounds/day. In the upper region of CCSeg05, surface water is lost to groundwater as the valley broadens into a depositional basin (Barton 2000). The expected or predicted loss in discharge in this reach was approximately 13 cfs (Table 5.5-2). Even though the dissolved cadmium load decreases in this reach (because of discharge to groundwater), significant cadmium loading occurred based on the expected increase in cadmium concentrations. Potential sources of metals in this reach include the Canyon Creek floodplain, Gem Mill Site and Gem No. 3.

In the reach between sampling locations CC284 and CC285, the second largest expected increase in cadmium loading (1.5 pounds/day) occurred within the seven reaches of Canyon Creek analyzed here. Modeling predicts that a large percentage (83 percent based on analysis of CC285) of the cadmium will reside in the dissolved form. However, the percentage of dissolved cadmium is lower than is found in previous reaches. This occurs because of the higher discharge rates. Higher discharges tend to suspend more particulates. More particulates result in more adsorption surfaces which bind with the cadmium. More adsorption surfaces and binding with cadmium result in more cadmium in particulate form (adsorbed) at the highest discharge rates. The expected discharge increased by 37 cfs in this reach. The number of potential sources within CCSeg05 are fewer than in CCSeg04 but three sources are contained within this reach, the Hecla-Star tailings ponds, the SVNRT tailings repository, and the impacted floodplain sediments are, in aggregate, a very large source. It is believed that groundwater interacts with floodplain tailings deposits under the Hecla-Star tailings ponds, the repository, and the floodplain and is subsequently discharged to the creek.

The largest expected increase in dissolved cadmium concentrations (11.1 μg/L) occurs in the reach bracketed by sampling locations CC285 and CC287/288. The expected dissolved cadmium load increases commensurately with the expected dissolved concentration (dissolved load increases by 2.6 pounds/day). The expected discharge decreased by approximately 22.6 cfs in this reach. Surface water is lost to groundwater in this reach because of the widening of the valley and the resulting broad depositional basin. Essentially all of the predicted cadmium load continues to exist as dissolved cadmium.

Typically, dissolved cadmium accounts for more than 80 percent of the total cadmium concentrations. Only at the highest discharge rates will the adsorbed or particulate cadmium concentration or load approach 50 percent of the total cadmium concentration or load. For example, at the mouth of Canyon Creek (CC288) during the May 1999 high-discharge event, the particulate cadmium concentration was 53 percent of the total cadmium concentration. Adsorption modeling indicated that increased pH values (> 1 pH unit) or increased ratios of adsorption sites/cadmium would be necessary to significantly increase the particulate load at the expense of the dissolved load.

5.5.4.4 Concentrations Versus Discharge

Figure 5.5-13 is a log-log regression plot of the dissolved cadmium concentrations versus discharge. There is a general decrease in cadmium concentrations at sampling location CC287/288 with increased discharge ($\alpha < 0.0001$). As one would expect, given that the majority of the cadmium is in the dissolved phase, there is also a decrease in total cadmium concentrations with increased discharge rates (plot not shown). The PDF shown as Figure 5.5-15 permits estimation of the dissolved cadmium concentrations at various discharge rates. Similar PDFs were developed at the other sampling locations. At all eight sampling locations there was an expected decrease in dissolved and total cadmium concentrations with increasing discharge rates (Appendix C).

Ion speciation solubility calculations with the MINTEQA2 geochemical computer code indicated there were no solid phases controlling cadmium concentrations in surface waters in the Coeur d'Alene basin and at the mouth of Canyon Creek. Decreasing cadmium concentrations with increased discharge rates supports this hypothesis by indicating that no solid is dissolving rapidly enough to achieve equilibrium with these surface waters. Otherwise, the concentrations would remain relatively constant at different discharge rates. As indicated in the solubility and adsorption modeling, adsorption is the most likely control on cadmium concentrations. Accordingly, mechanistic modeling supports conclusions inferred from the PDFs. This indicates the potential of the probabilistic approach to elucidate important mechanisms in addition to making estimations of concentrations, loads, and data uncertainties.

5.6 SEDIMENT FATE AND TRANSPORT

Brief summaries of sediment transport processes active in the watershed are presented in this section, followed by descriptions of sediment sources and transport processes observed in each segment.

5.6.1 Sediment Transport Processes

The physical processes of rain falling on soil, runoff from snowmelt or precipitation, channel bank and bed erosion, or mass movement incorporates sediment into streams of water. Water in streams transports, deposits, and sorts the delivered sediment based on the stream energy, discharge, and size and quantity of sediment.

Sediment transport by streams is a natural process; however, human activities such as mining, logging, road building, urbanization, or land clearing can significantly increase the rate at which sediment transport occurs. For instance, land clearing exposes soil and rock that may be subject to erosion. Further, this disturbance may decrease the amount of water storage in the soil, increasing runoff rates and providing additional surface water and energy for sediment transport.

The rate at which sediment passes through a cross section of a stream system is referred to as the sediment yield. This annual sediment yield may be broken down into components that describe the method of transport, suspended load and bedload. Suspended load consists of particles small and light enough to be carried downstream in suspension by shear and eddy forces in the water column. Bedload consists of larger and heavier particles that move downstream by rolling, sliding or hopping on the channel bed (Dunne and Leopold 1978).

Sediment transport (particulate metal loading) occurs at even the smallest of stream channel discharge but the majority of movement occurs during moderate to high discharge when shear forces are greatest (Leopold et al. 1992). High-flow periods usually occur in the spring as a result of precipitation and snowmelt but can occur in midwinter for the same reasons. Physical erosion of riverbanks and channels during high-flow events causes particulate forms of metals to reenter the river and be transported. There is a propensity for increased erosion during high-flow events and following high-flow events when river banks are saturated and the river stage decreases and a propensity for sediment deposition as river stage decreases. Upon entering Canyon Creek, dissolved and particulate metals are transported downstream. In general, where the creek widens into floodplains there is a tendency for surface water to discharge dissolved metals to groundwater and deposit suspended sediment onto the streambed.

As suspended or bedload particles are transported by the river system, there is a possibility that metals will desorb from the sediments and enter the river in the dissolved phase. Furthermore, metals may enter the river from riverbank porewater. During high-flow events, riverbanks and adjacent floodplain areas store water. The stored pore water can increase in concentration as metals desorb from sediments or as precipitated solid phases and minerals dissolve. As the waters subside, these dissolved metals reenter the river system and are transported.

Sediment derived in Canyon Creek is transported through the system and into the South Fork. Sediment sources in Canyon Creek are rock debris situated adjacent to channels, channel bed sediment, bank erosion, and road drainage. Based on USGS sediment transport and stream discharge data, approximately 1,400 tons of sediment were transported out of Canyon Creek in water year 1999 (USGS 2000): approximately 60 percent as fines, 37 percent as sand, and

3 percent as bedload. Based on estimates of historical surface water and sediment discharge, this was below average for the period 1990 to 1999.

Suspended sediment and bedload samples were not analyzed for total metals; therefore mass loading was estimated from total and dissolved surface water data as described in Sections 5.3 through 5.5.

5.6.2 Segment Descriptions

CCSeg01 has approximately 12,000 feet (2.3 miles) of mapped channel. Through this segment Canyon Creek flows through a broad valley bottom more than 200 feet wide. The valley bottom is vegetated with conifers throughout the reach. Significant sediment sources were not identified in this segment; however, likely minor sediment sources in this segment include remobilization of channel bed sediment and bank erosion. Data were not available on soil and sediment metals concentrations.

CCSeg02 has approximately 6,000 feet (1.1 miles) of mapped channel. The channel through this segment is constrained by roads and hillslopes. Several rock debris deposits on the hillslopes surrounding and adjacent to Canyon Creek are likely sources of sediment in this segment. Additional sources are remobilization of channel bed sediment. Metals concentrations in floodplain sediment samples exceeded screening levels for lead and silver.

CCSeg03, Gorge Gulch, has approximately 7,000 feet (1.3 miles) of mapped channel. The channel slope ranges from 10 to 30 percent. The high gradient of this channel likely provides efficient transport of sediment supplied to the channel. The channel through this segment is confined by steep valley walls with several deposits of rock debris located adjacent to the ravine bottom. Numerous logging and other dirt roads cross the hillslopes surrounding the channel. Sediment sources in this segment include remobilization of channel bed sediment, sediment derived from rock waste piles, and sediment derived from road drainage. Metals concentrations in floodplain soil samples exceeded screening levels for cadmium, copper, iron, lead, and zinc.

CCSeg04 has approximately 19,000 feet (3.6 miles) of mapped channel. Channel slope varies from 1 to 10 percent. The majority of past mining and milling activities occurred within this segment. Numerous piles of rock, tailings, and soil debris have been placed near or adjacent to channels or in other potentially unstable areas. The entire length of Canyon Creek in this segment is constrained to a relatively narrow valley by steep hillslopes, roads and dikes. Little lateral migration of Canyon Creek occurs in this segment. Logging and other dirt roads cross the hillslopes; drainage and sediment generated from these roads flow into Canyon Creek. Likely sediment sources include minor bank erosion, tailings, remobilization of channel bed sediment, rockfall, road drainage, and soil and rock deposits scattered throughout the segment. This segment is mostly erosional, with few depositional areas. Metals concentrations in floodplain sediment samples exceeded screening levels for antimony, arsenic, cadmium, copper, iron, lead, mercury, silver, and zinc.

CCSeg05 has approximately 17,000 linear feet (3.2 miles) of mapped channel. The channel slope is relatively constant, ranging from 1 to 4 percent with slightly higher slope in the upper reaches. Little mining or milling activities have been conducted in this segment; however, tailings and other sediment from upstream mining and milling operations have been deposited in the floodplain around Woodland Park. Tailings dams 200 to 300 feet wide currently contain tailings deposits in the floodplain around and upstream of Woodland Park. Rehabilitation work, including channel stabilization measures, has been completed throughout this segment. Based on aerial photograph and topographic map interpretation, the major source of suspended sediment, and dissolved metals in surface water, in this segment appears to be mobilization of channel bed sediment. Metals concentrations in floodplain soil and sediment samples exceeded screening levels for all ten COPCs. Metals in depositional floodplain sediments in this segment will be remobilized into the water column and moved downstream into the South Fork during high-flow discharge events as both suspended sediment and dissolved metals in surface water.

5.6.3 Summary of Sediment Transport

Approximately 1,400 tons, or 62 tons per square mile, of sediment was transported from Canyon Creek to the South Fork Coeur d'Alene River in water year 1999. Sediment sources occur in all five segments. Based on interpretation of aerial photographs from 1984, 1991, and 1998, the majority of the sediment supplied to the creek appears to originate in Segments CCSeg03 through CCSeg05. Large rock and soil deposits are positioned adjacent to the stream channel and on hillslopes, which drain to the stream in CCSeg03 and CCSeg04. Lateral migration of the channel has been observed in the historical aerial photographs in CCSeg04 and CCSeg05. Channelization, bed controls, deposition pools, and configuring rock and soil deposits away from the channel have previously been used in these segments to reduce the sediment yield of the basin. These efforts have likely reduced the sediment load. The sediment yield has also presumably been reduced through time since discharging mine-related debris directly into the channel has ceased.

Suspended sediment and bedload samples were not analyzed for total metals; therefore, mass loading was estimated from total and dissolved surface water data as described in Sections 5.3 through 5.5. Floodplain soil and sediment samples, representative of suspended sediment deposited during low-flow events, were analyzed for total metals. Metals concentrations in floodplain soil and sediment samples exceeded screening levels in CCSeg02 through CCSeg05. Metals in depositional floodplain sediments will be remobilized into the water column, moved downstream, and eventually enter the South Fork during high-flow discharge events as both suspended sediment and dissolved metals in surface water.

5.7 SUMMARY OF FATE AND TRANSPORT

The probabilistic model was used to quantify and summarize the available data and to estimate metals concentrations in surface water and mass loading to Canyon Creek. Sediment transport was evaluated using USGS suspended and bedload sediment discharge data and measured floodplain soil and sediment data. Results are summarized in this section.

Surface water discharge, metals concentrations (total and dissolved), and mass loading data were analyzed using lognormal probability density functions at eight separate sampling locations in Canyon Creek. Only results for cadmium, lead, and zinc were analyzed. Regressions were developed for total and dissolved concentrations versus discharge to quantify and identify trends in concentrations and mass loading with changing discharge rates. The percentages of dissolved and particulate forms of metals were computed from the estimated expected values predicted by the model.

Results of the probabilistic modeling indicate:

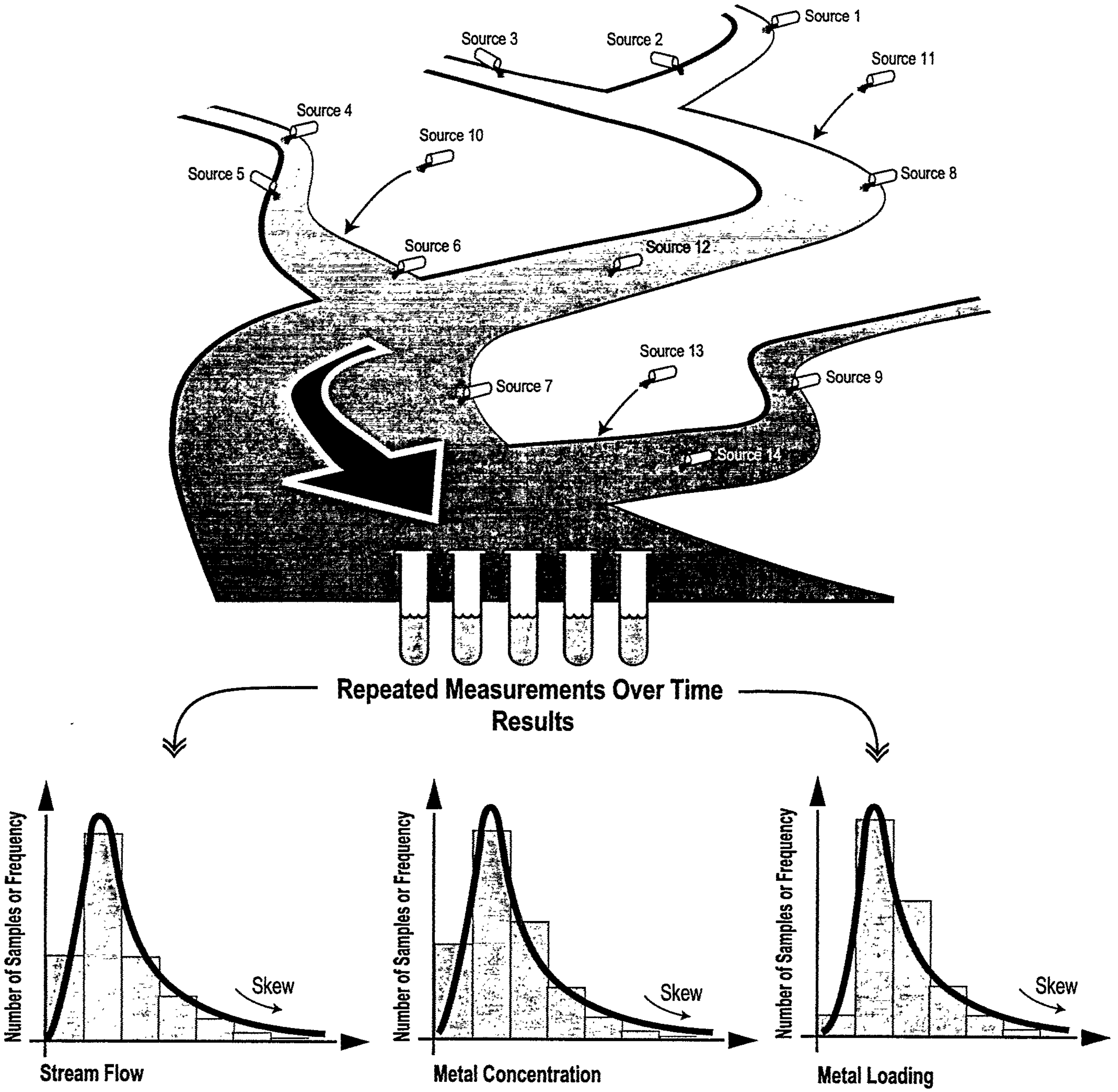
- The expected value of the dissolved zinc concentration at CC2 (approximately 26 μg/L) is less than the screening level of 42 μg/L. At the next downgradient sampling location (CC276), the estimated value (approximately 122 μg/L) exceeds the screening level. The screening level is exceeded at all subsequent sampling locations. The highest estimated expected value of the dissolved zinc concentration (2,996 μg/L) is approximately 70 times the screening level.

- Expected values of cadmium, lead, and zinc concentrations exceeded screening levels in CCSeg03 through CCSeg05. Expected metal concentrations are compared with screening levels for each of the eight sampling locations in Figures 5.7-1 through 5.7-6.

- The expected value of the dissolved zinc load at the first sampling location (CC2 above Burke) is approximately 0.3 percent of the estimated load arriving at the mouth of Canyon Creek. The expected value of the dissolved zinc load

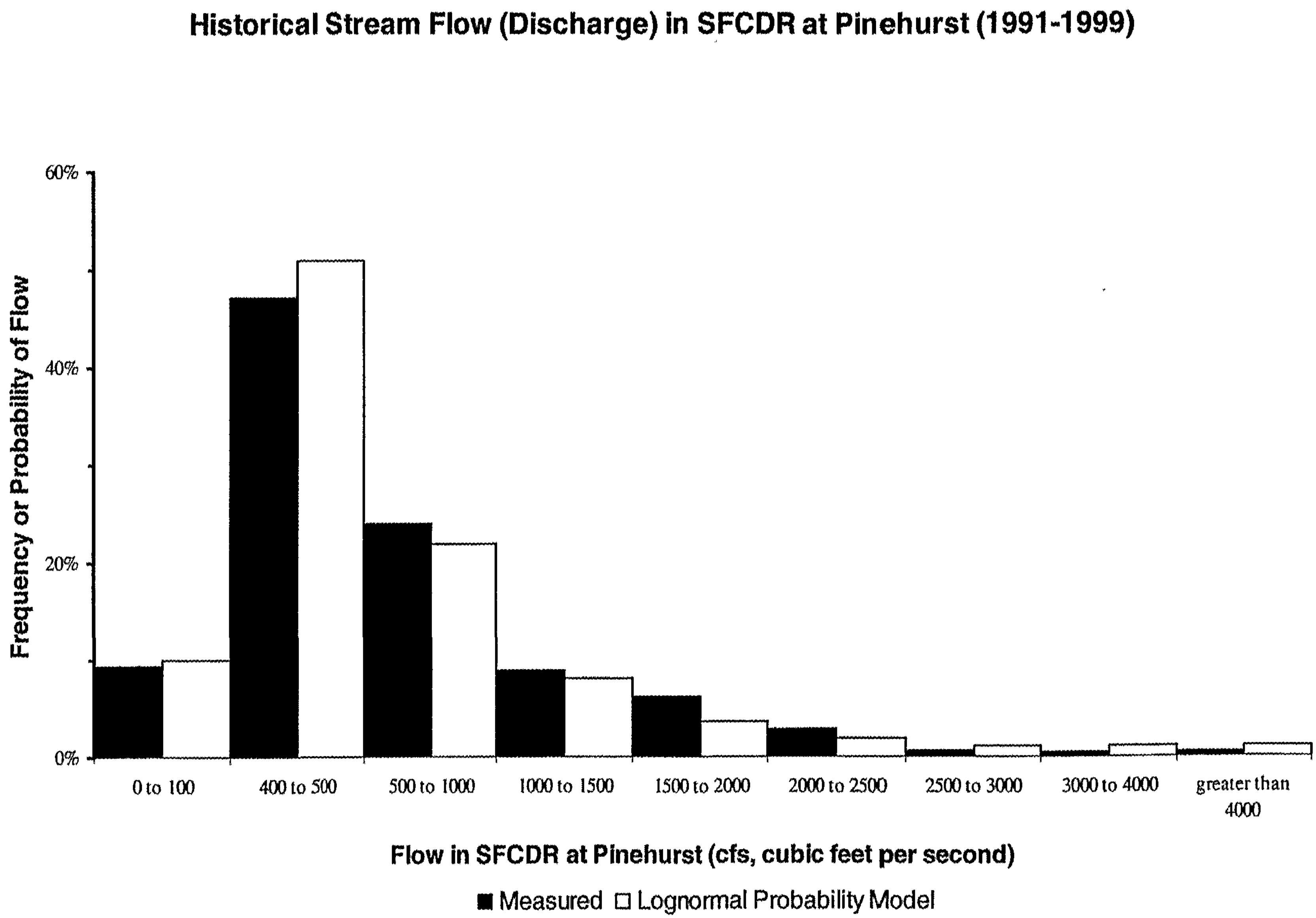
(2 pounds/day) at CC2 is less than the 10th percentile TMDL (3.79 pounds/day). At sampling location CC278 the expected value of the dissolved zinc load (34 pounds/day) exceeds the TMDL at the 90th percentile (25.9 pounds/day).

- Expected values of cadmium, lead, and zinc mass loading exceeded TMDLs in CCSeg03 through CCSeg05.
- CCSeg04 is estimated to contribute approximately 220 pounds/day to the dissolved zinc loading. CCSeg05 is estimated to contribute approximately 329 pounds/day to the dissolved zinc loading.
- The estimated expected values of discharge, dissolved zinc and cadmium and total lead concentrations, and loads generally increased with increasing distance downstream (Figures 5.7-7 through 5.7-9 and Table 5.7-1).
- The estimated dissolved zinc load at the mouth of Canyon Creek (556 pounds/ day) is more than 20 times the TMDL at the 90th percentile.
- Lead tends to be associated with the particulate phase, while cadmium and zinc tend to be in the dissolved phase.
- Major source areas identified in the watershed are listed in Table 5.7-2. Identification of major source areas was primarily based on the estimated contributions of sites to dissolved zinc loading in surface water of the Coeur d'Alene River basin. The identification process and backup documentation is presented in Draft Technical Memorandum No. 1: Candidate Alternatives and Typical Conceptual Designs, Coeur d'Alene Basin Feasibility Study (URSG and CH2M HILL 2000).



Stream flow, metal concentration, and metal loadings all show lognormal distributions

EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI PEPORT	Doc. Control: 4162500.6615.05.a Generation: 1 RI-3111 051700	**Figure 5.4-1** **Stream Sampling, Lognormal Distributions**



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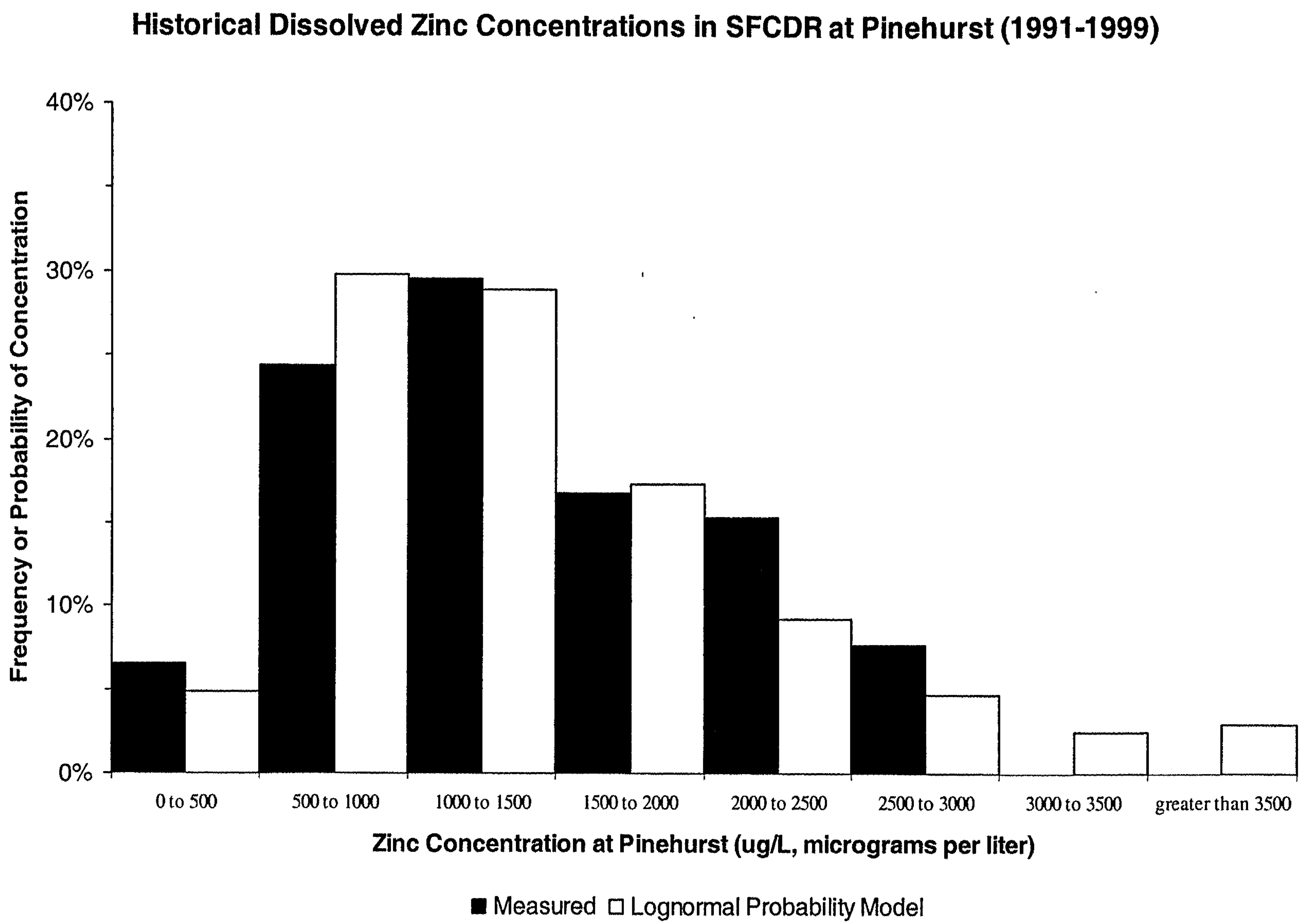
Coeur d'Alene Basin RI/FS
RI REPORT

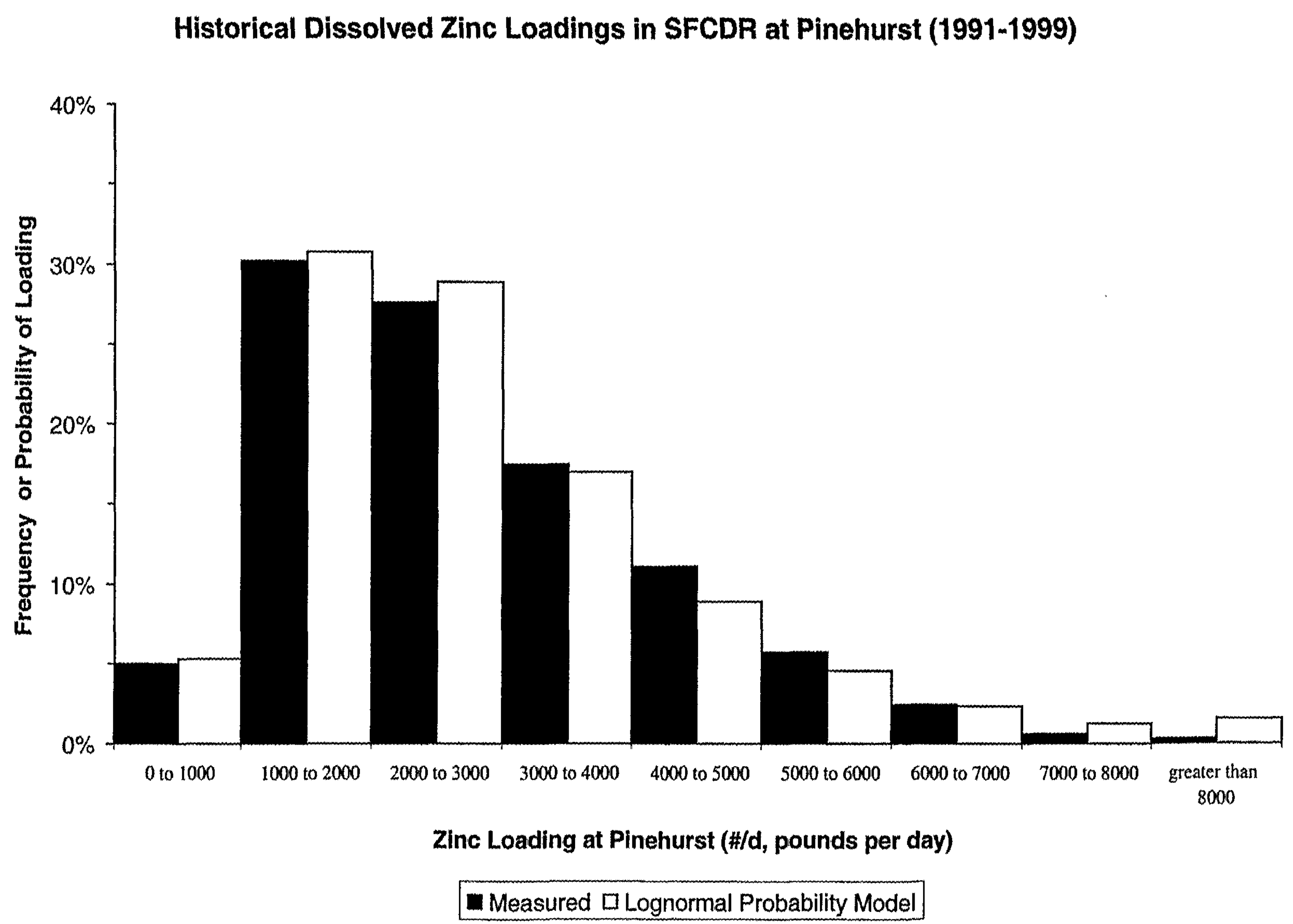
Doc Control: 4162500.6615.05.a
Generation: 1

Canyon Creek Series
07/19/01

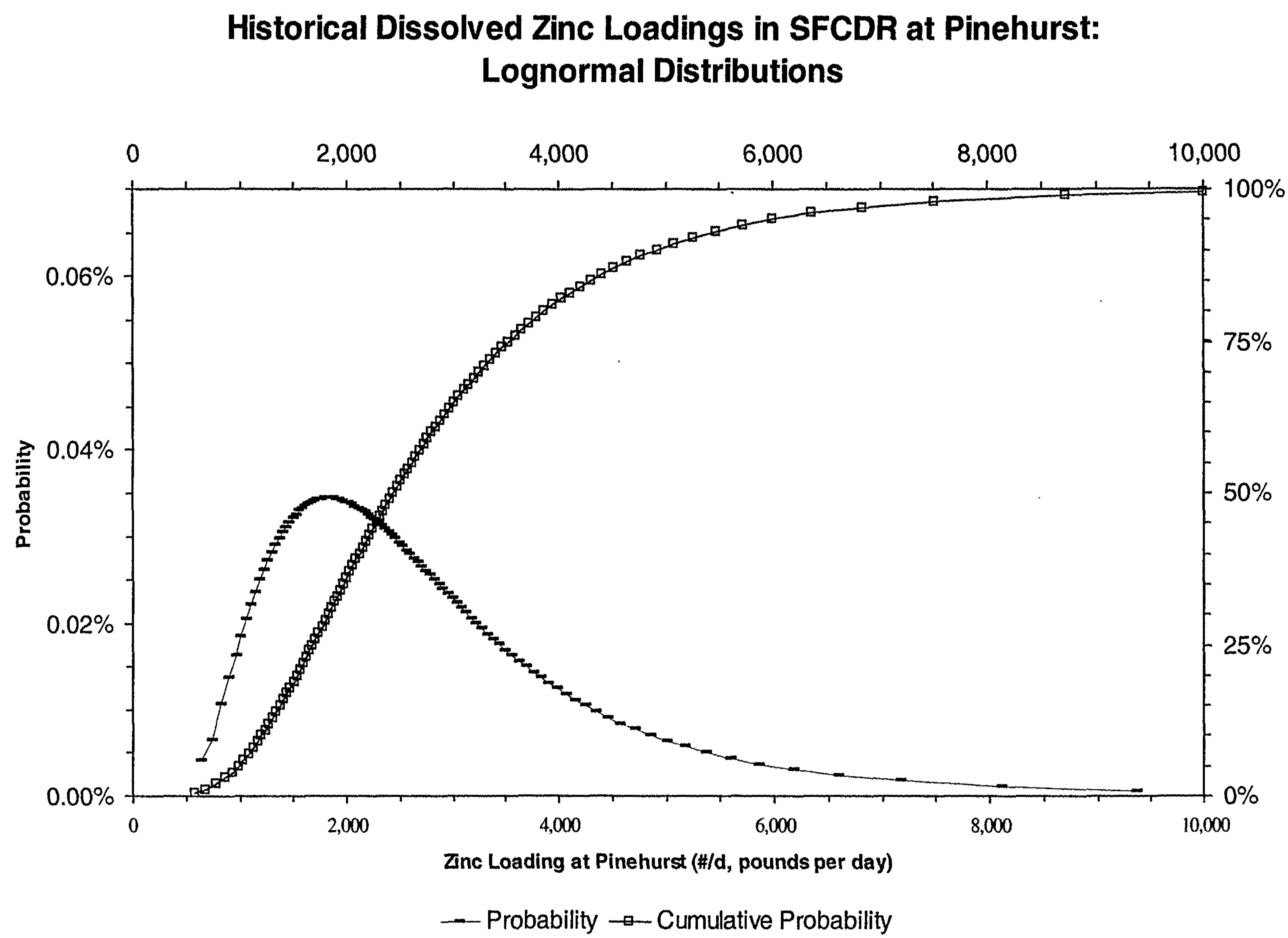
Figure 5.4-2



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.4-3



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.4-4



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.4-5

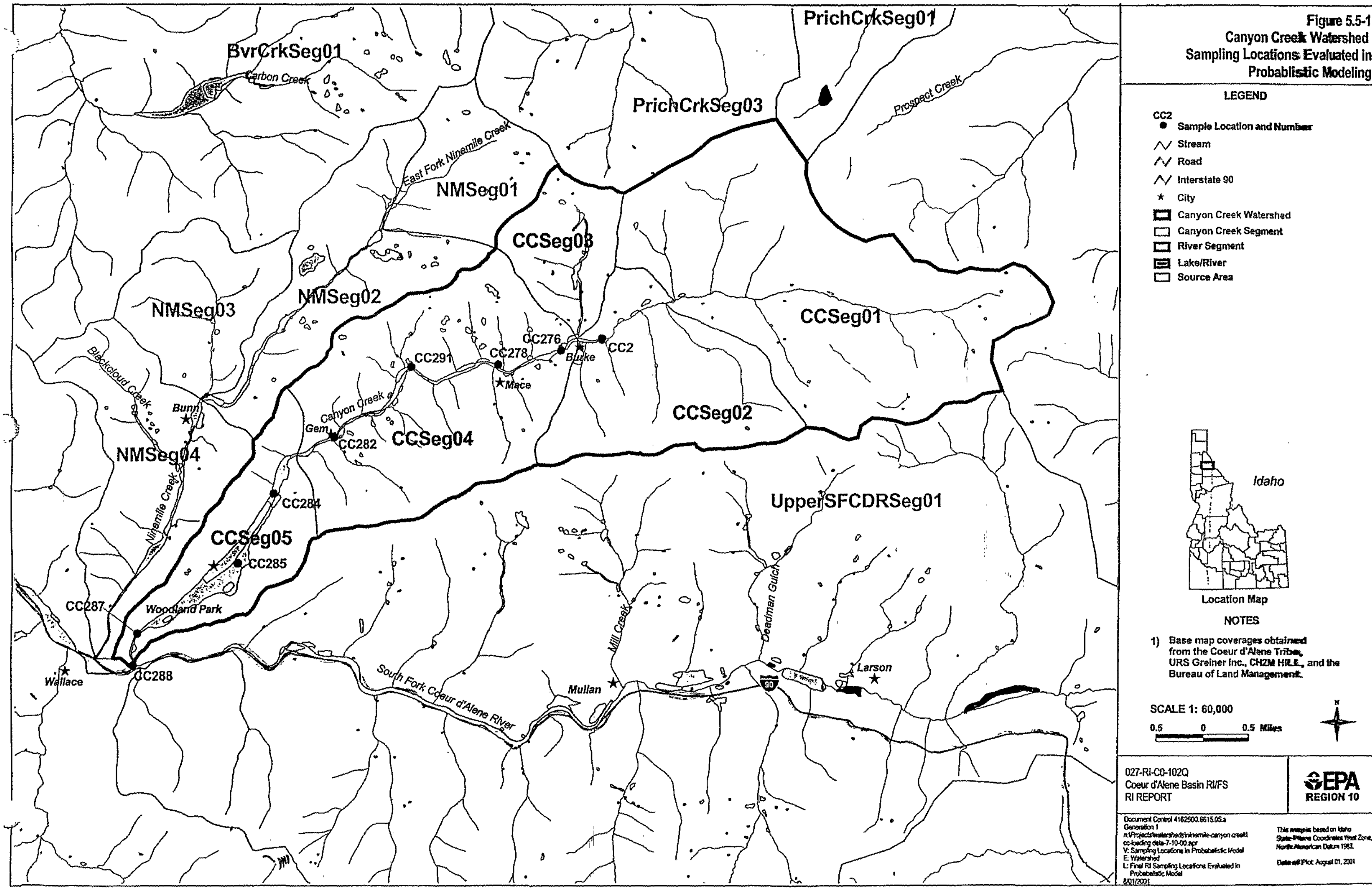
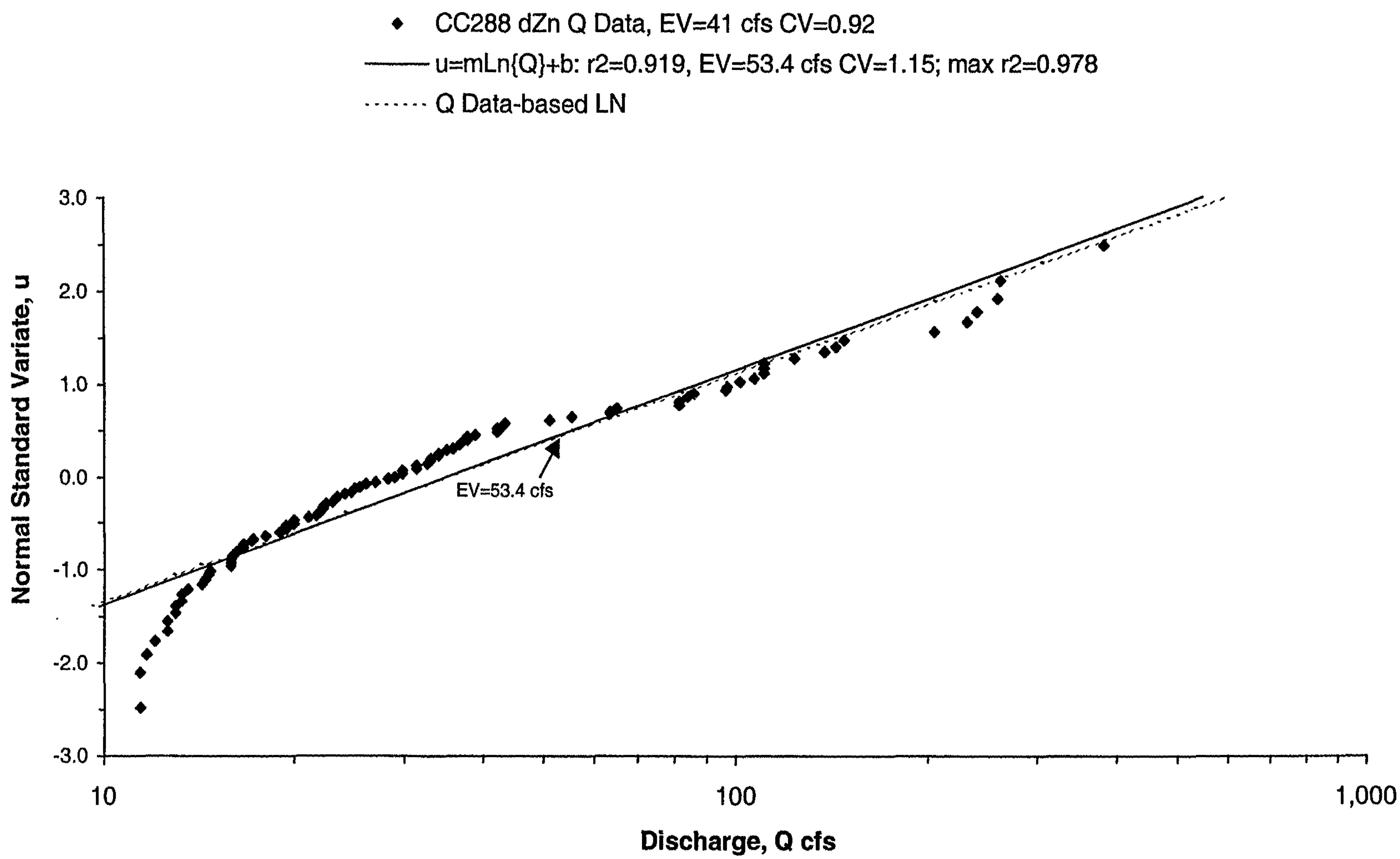
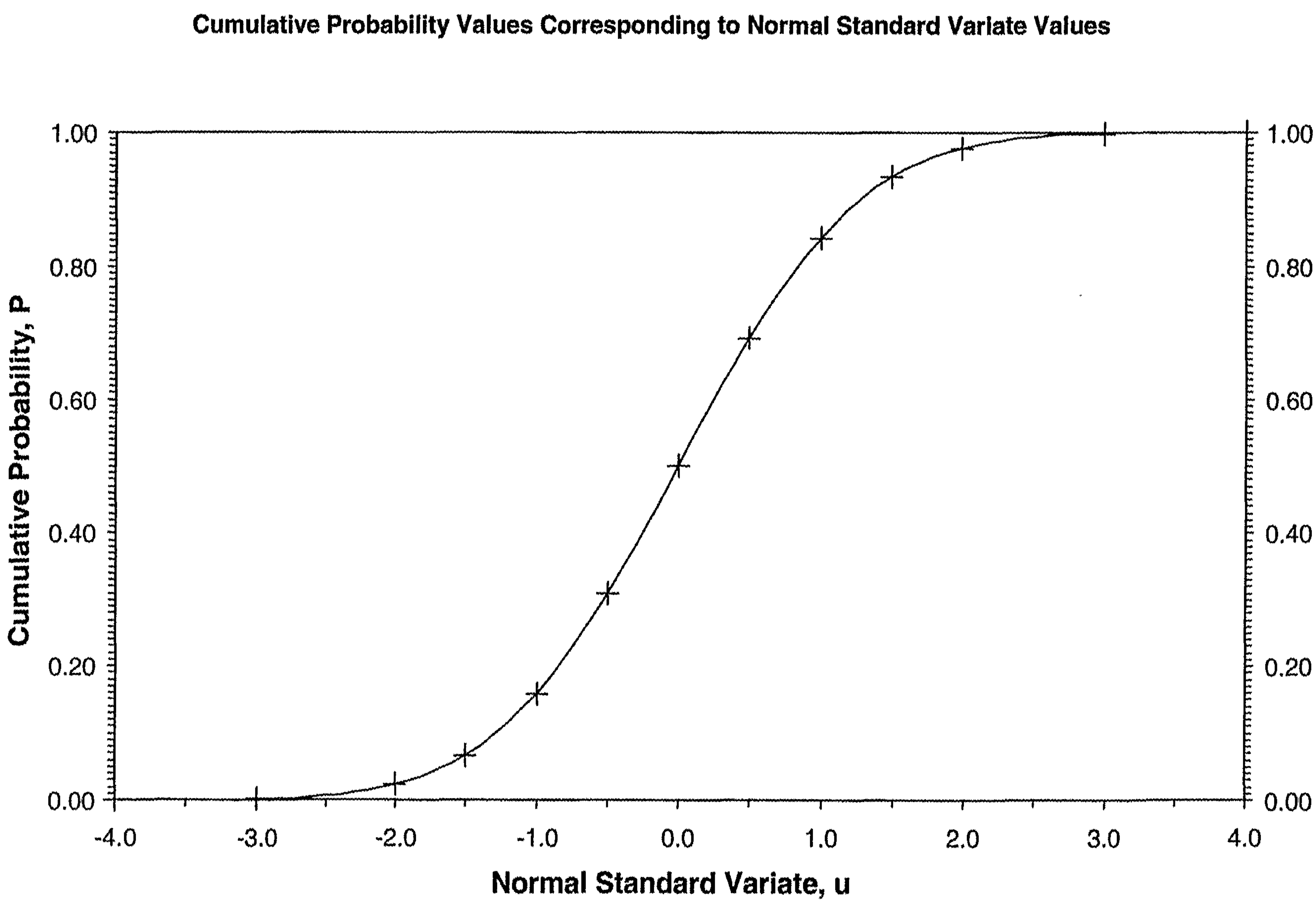


Figure 5.5-1
Canyon Creek Watershed
Sampling Locations Evaluated in Probablistic Modeling

Probabilistic Modeling Results for Discharge at CC287/288



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.5-2



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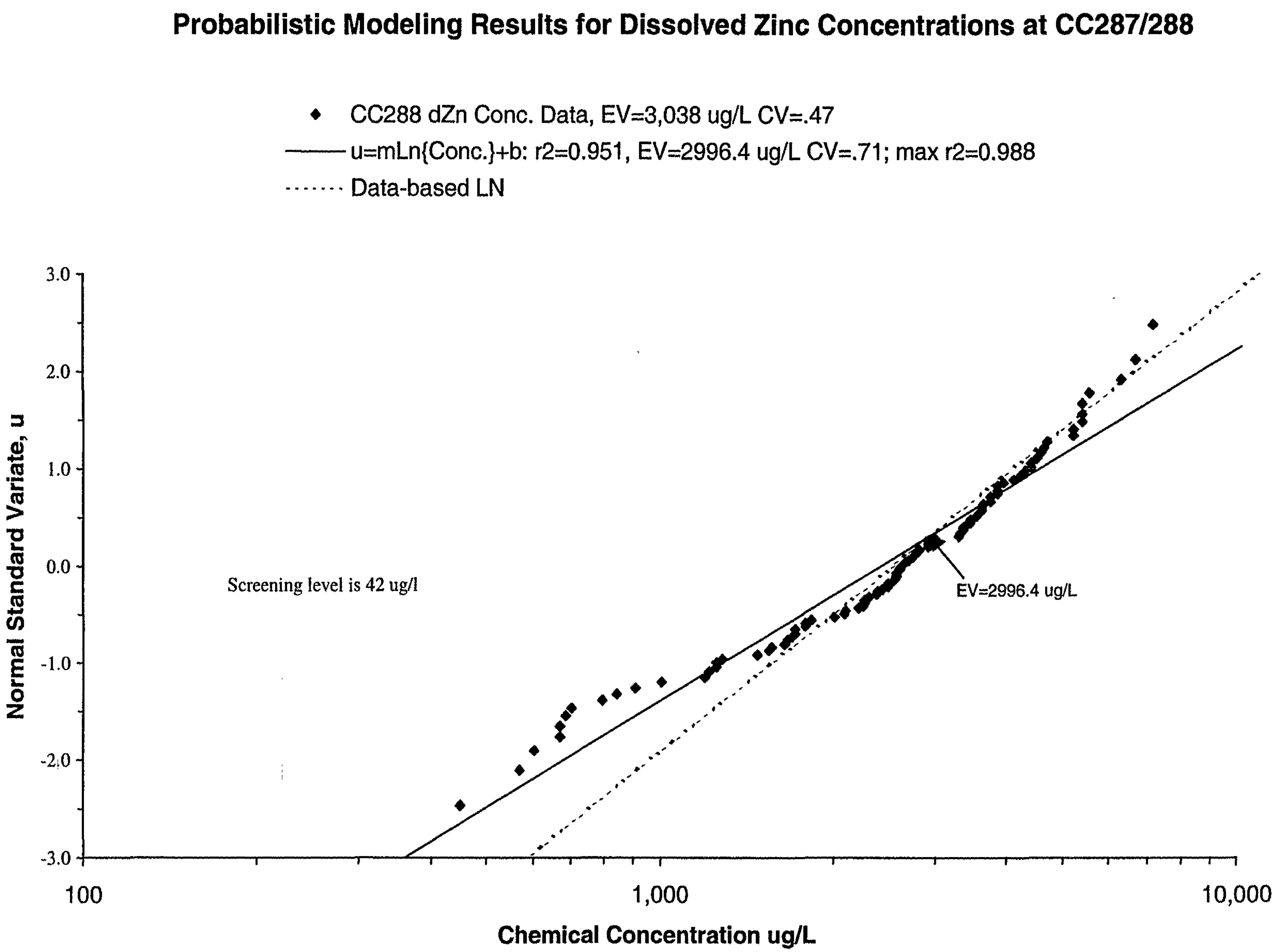
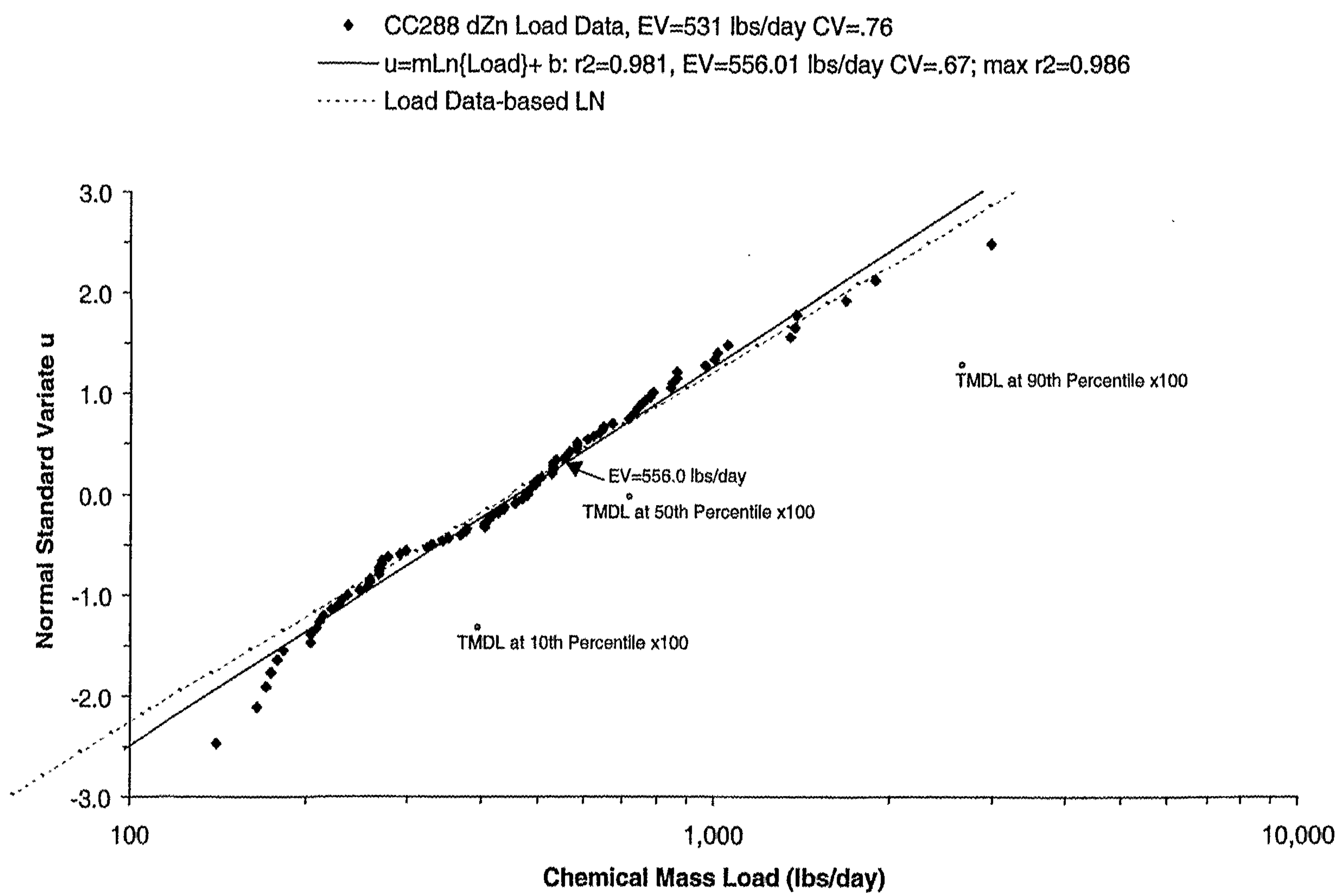
Canyon Creek Series
07/19/01

Figure 5.5-3

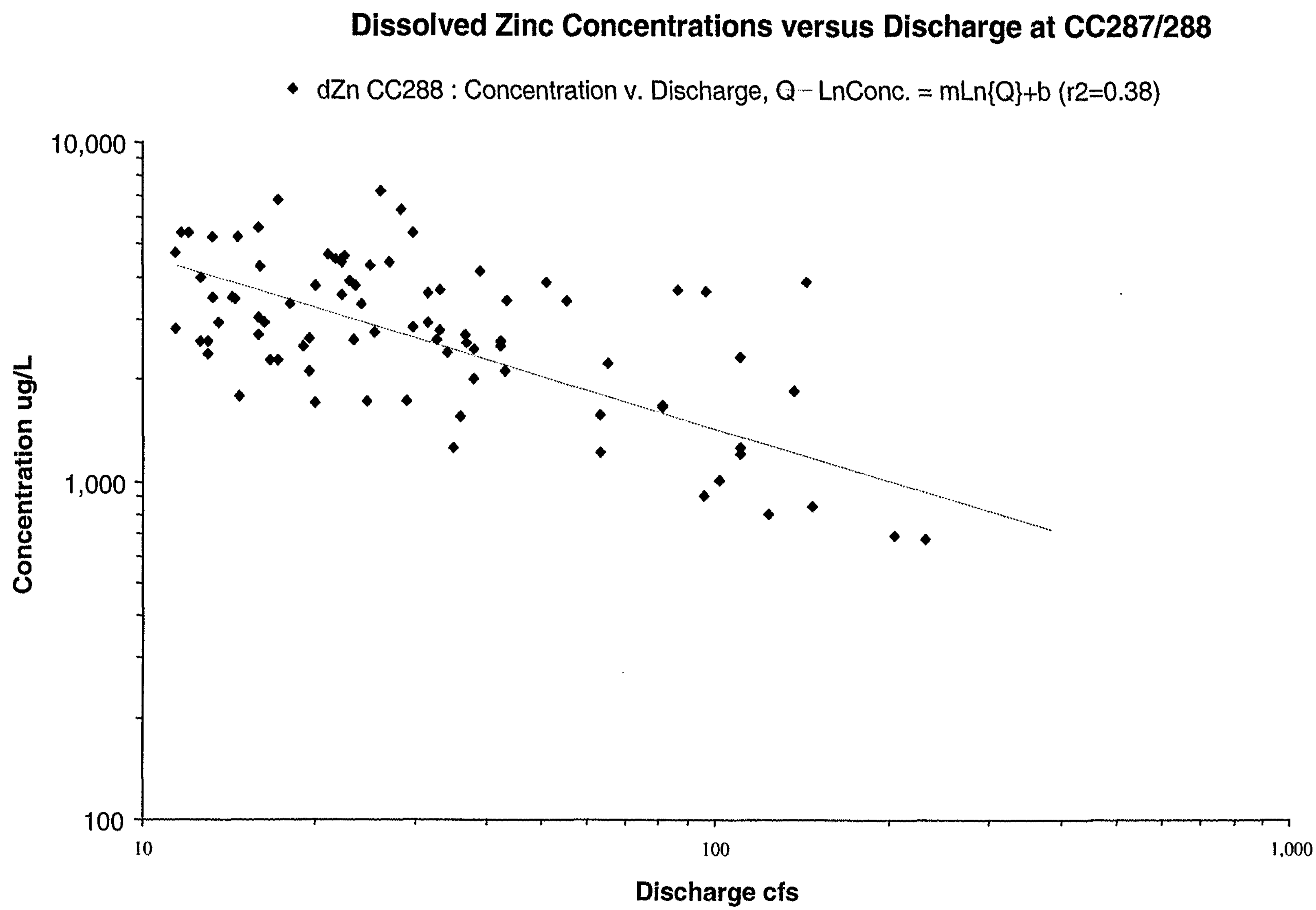


EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.5-4

Probabilistic Modeling Results for Dissolved Zinc Mass Loading at CC287/288



EPA REGION	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.5-5



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Coeur d'Alene Basin RI/FS
RI REPORT

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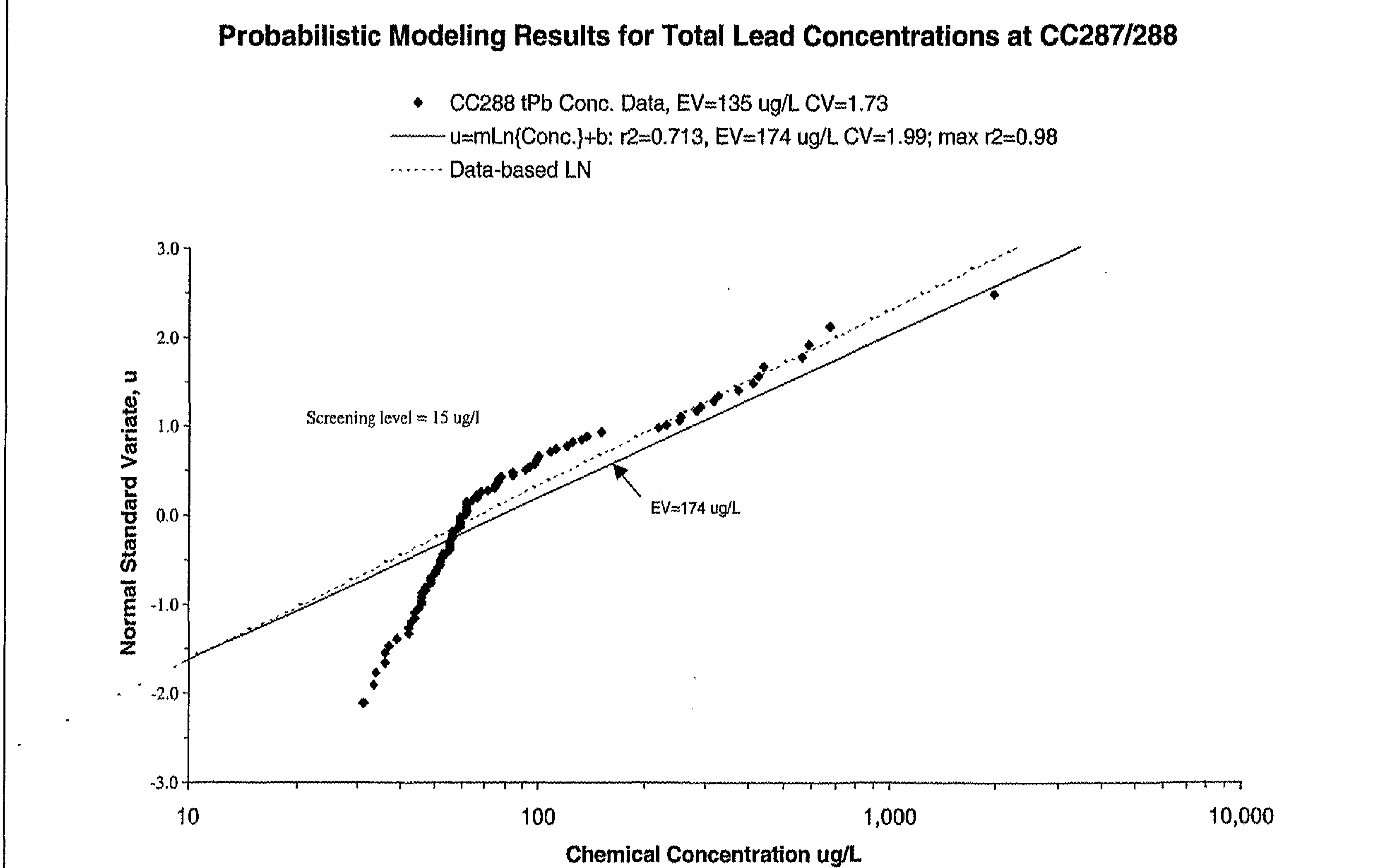
Canyon Creek Series
07/19/01

Figure 5.5-6



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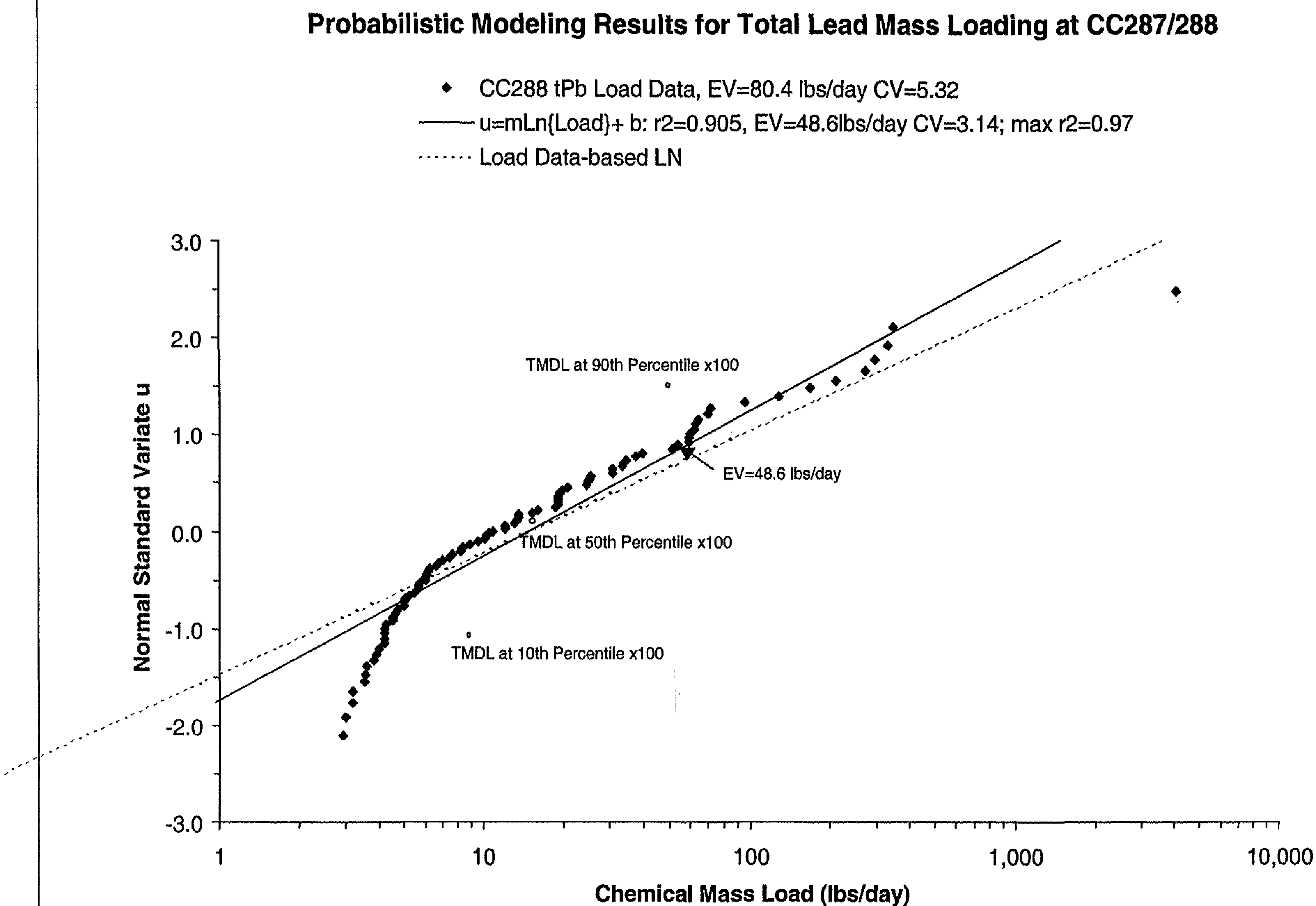
Canyon Creek Series
07/19/01

Figure 5.5-7



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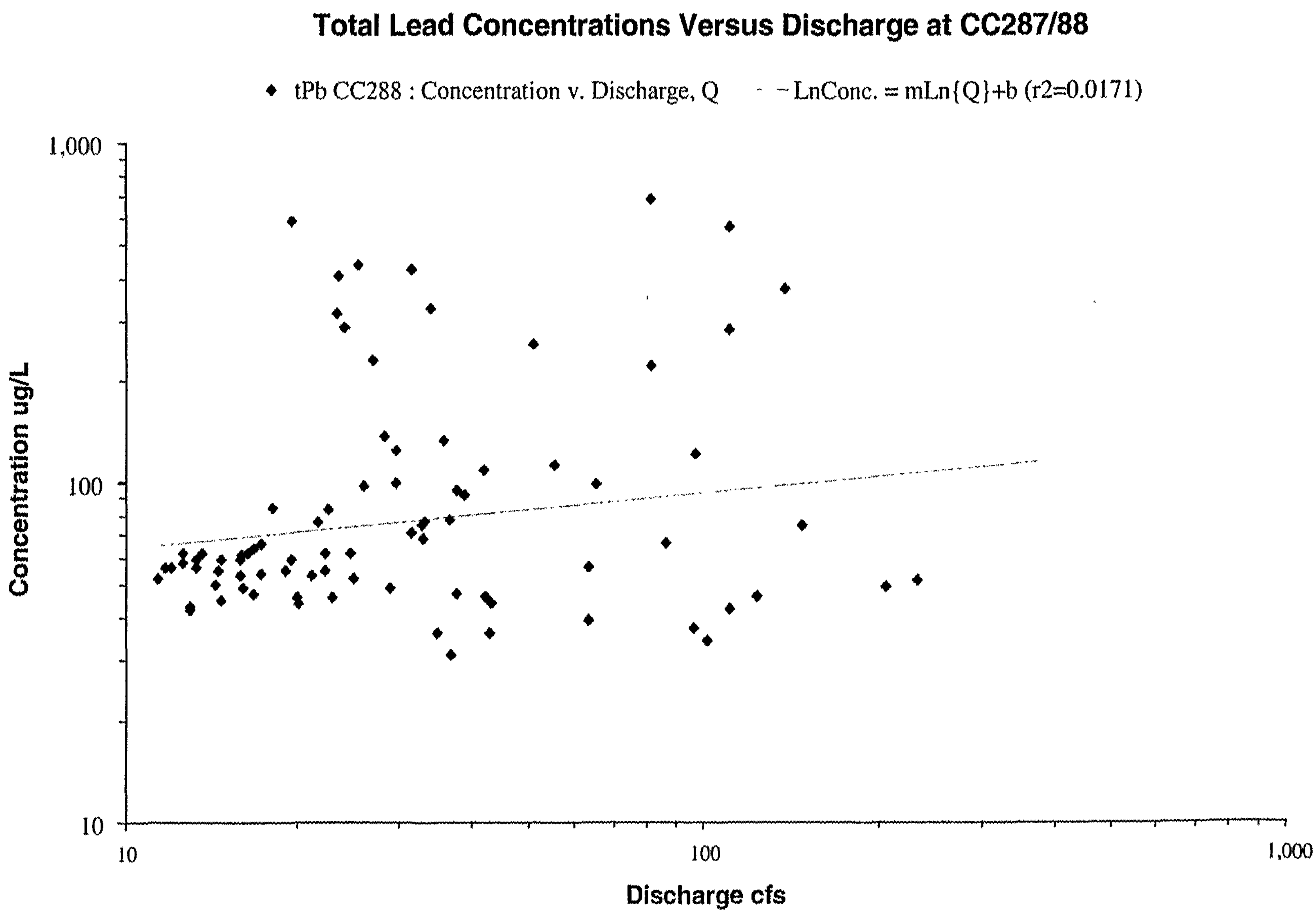
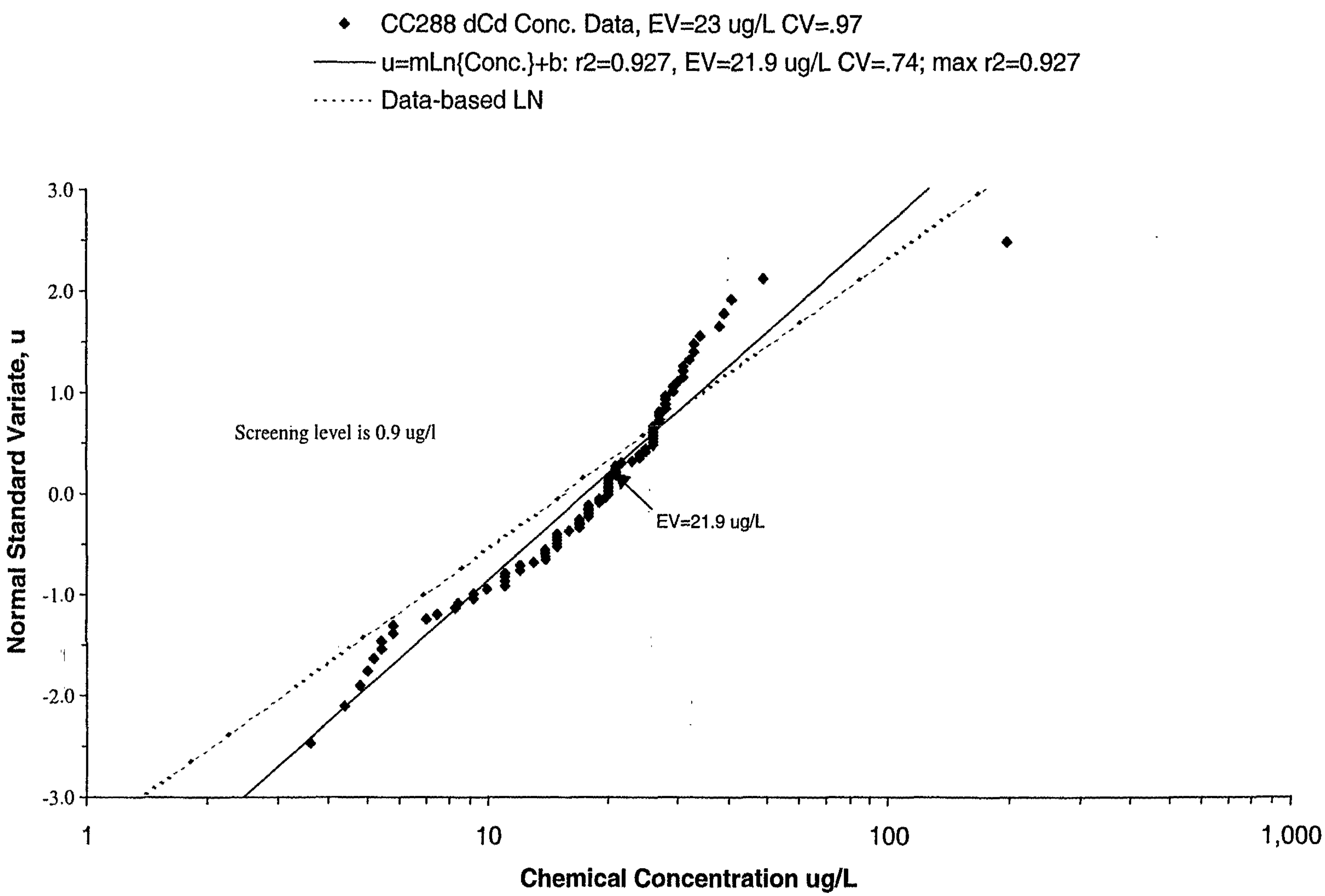


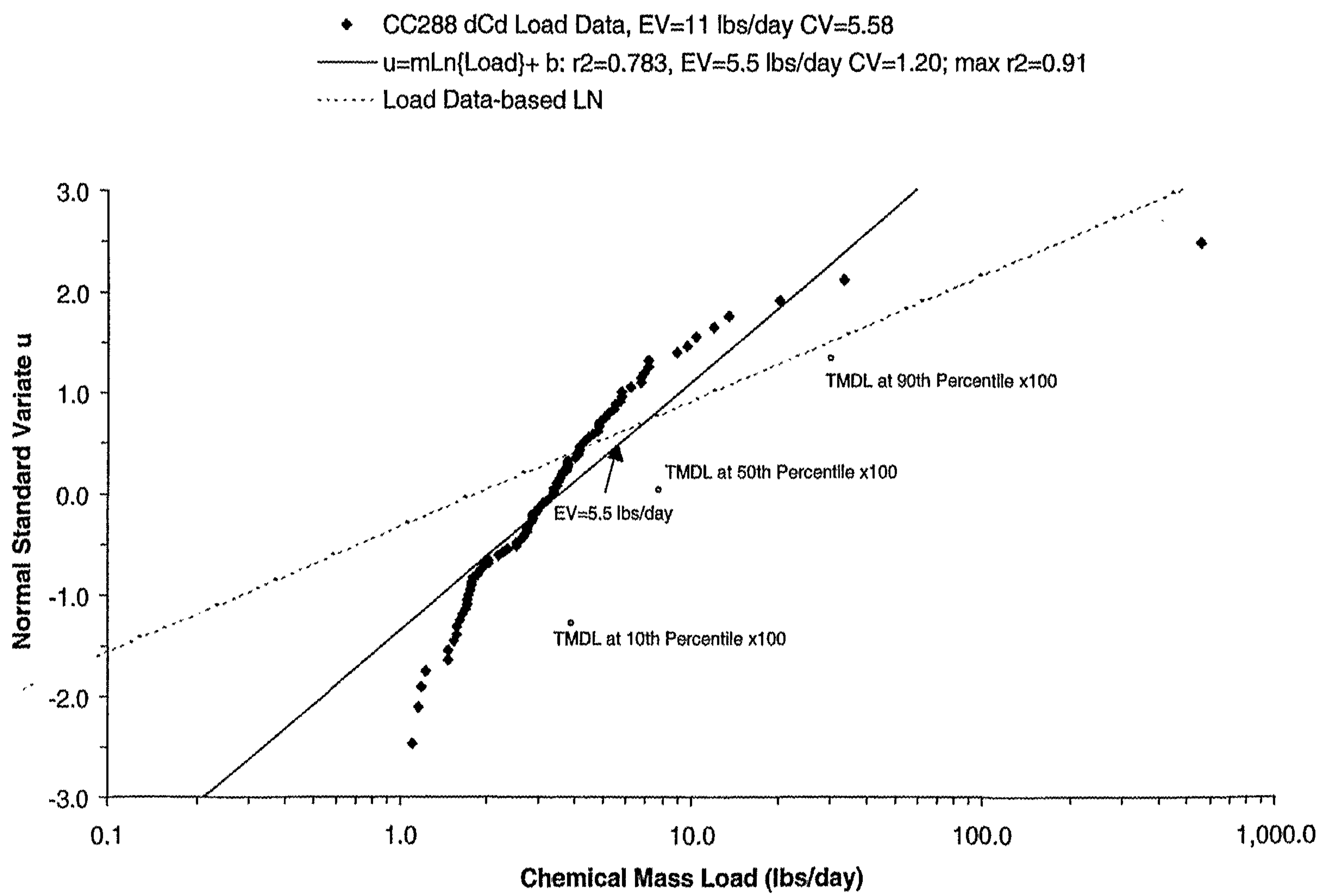
EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.5-9

Probabilistic Modeling Results for Dissolved Cadmium Concentrations at CC287/288

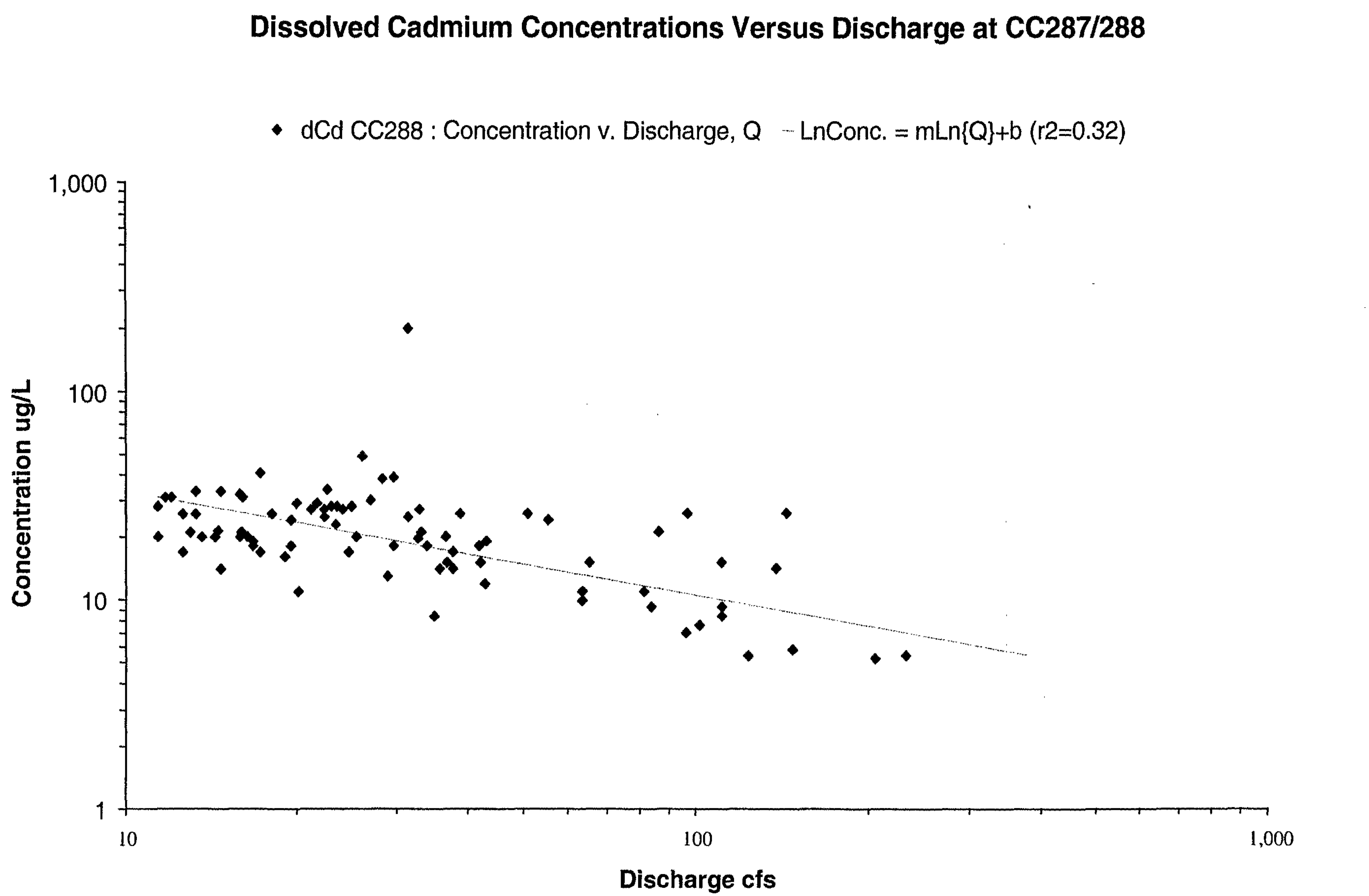


EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.5-10

Probabilistic Modeling Results for Dissolved Cadmium Mass Loading at CC287/288



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.5-11



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	**Figure 5.5-12**

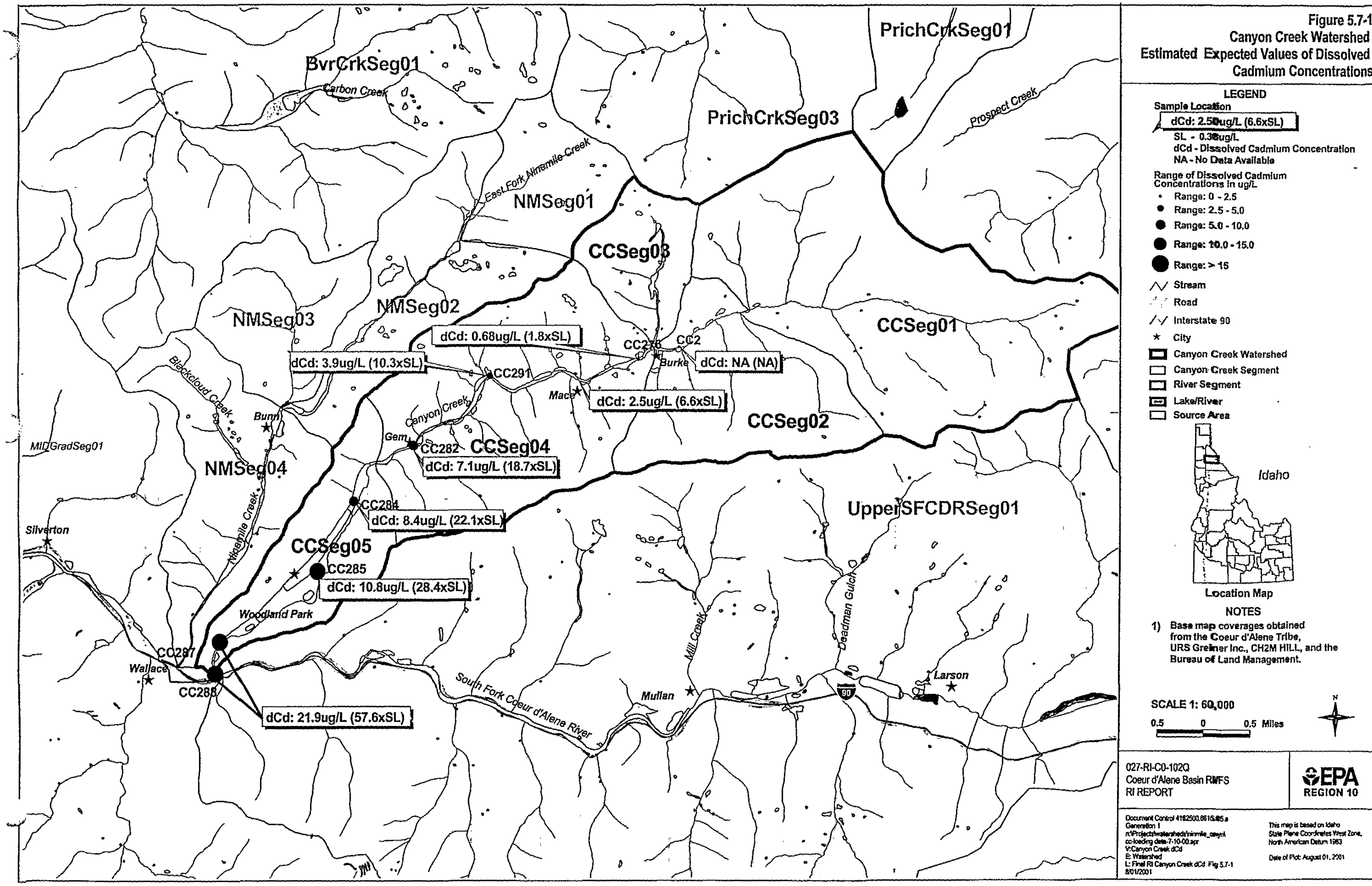
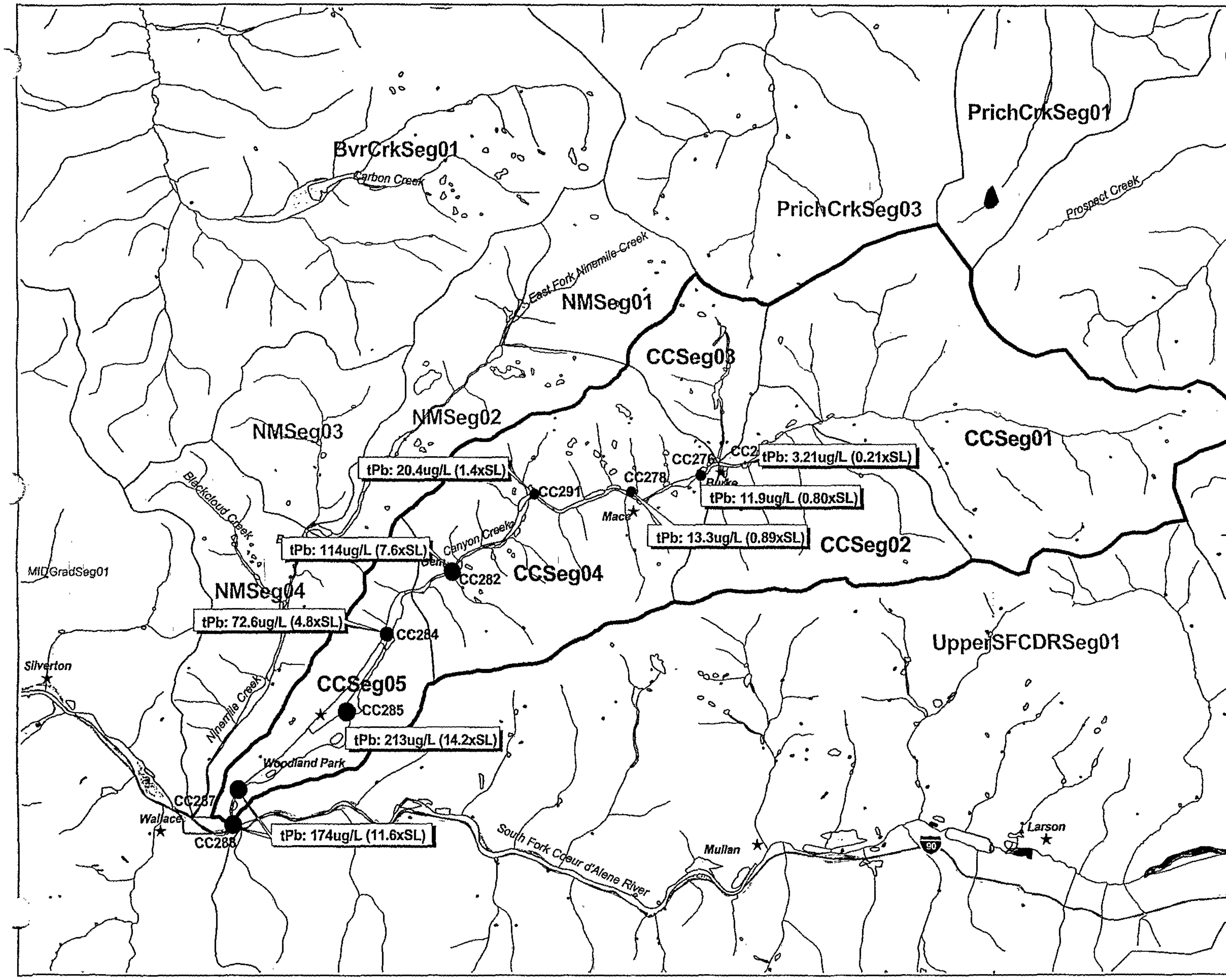


Figure 5.7-1
Canyon Creek Watershed
Estimated Expected Values of Dissolved Cadmium Concentrations

Figure 5.7-2
Canyon Creek Watershed
Estimated Expected Values of
Total Lead Concentrations



LEGEND

Sample Location
tPb: 3.2ug/L (0.21xSL)
SL - 15ug/L
tPb - Total Lead Concentration

Range of Total Lead Concentrations in ug/L
- Range: 0 - 5.0
- Range: 5.0 - 10.0
- Range: 10.0 - 50.0
- Range: 50.0 - 100.0
- Range: > 100

- Stream
- Road
- Interstate 90
- City
- Canyon Creek Watershed
- Canyon Creek Segment
- River Segment
- Lake/River
- Source Area

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

SCALE 1: 60,000
0.5 0 0.5 Miles

027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA
REGION 10

Document Control 4162500.6815.05.a
Generation 1
n:\Projects\watersheds\
cc-loading data-7-10-00.apr
V: Canyon Creek tPb
E: Watershed
L: Final RI Canyon Creek tPb Fig 5.7-2
8/01/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot, August 01, 2001

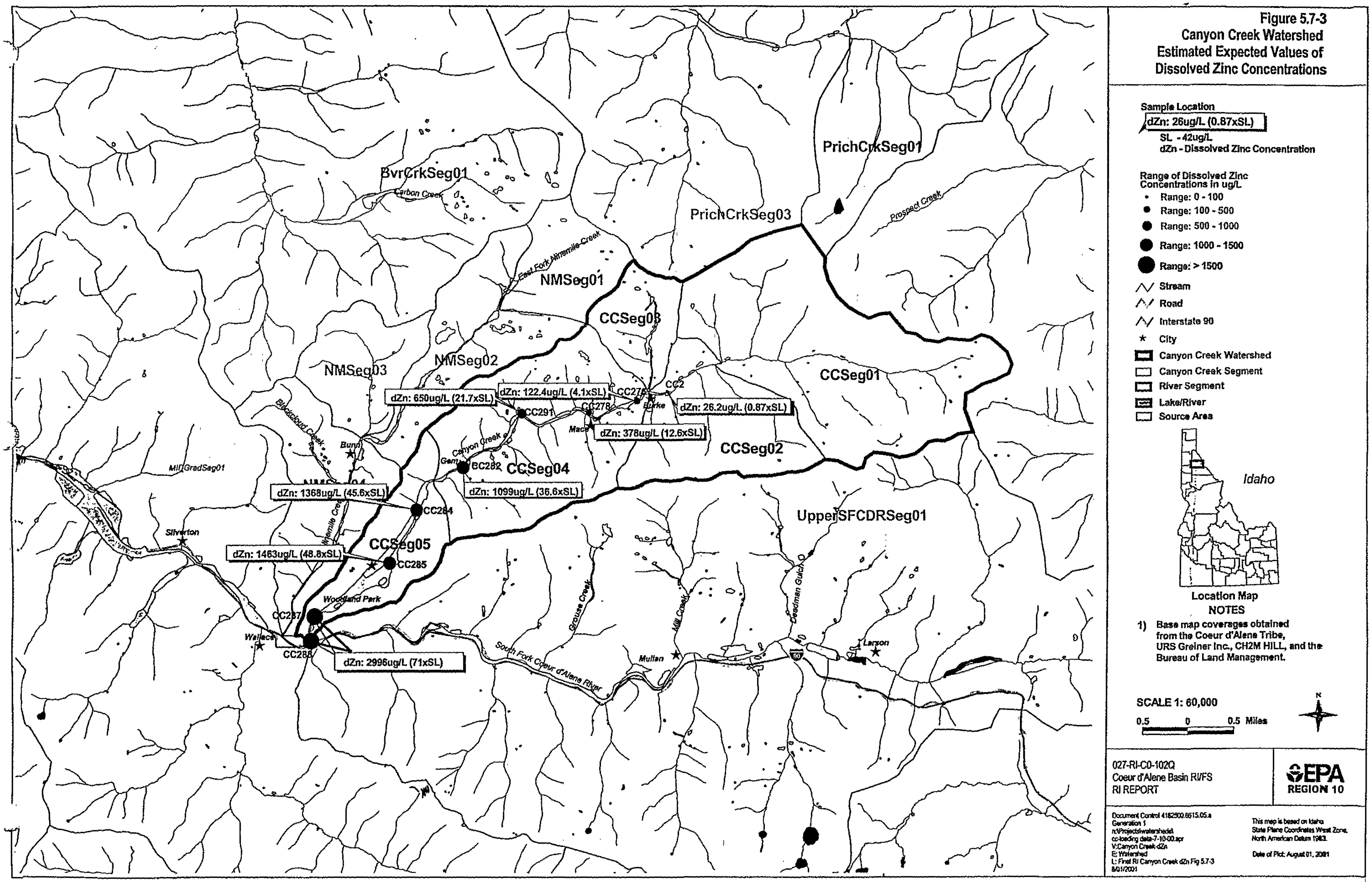


Figure 5.7-3
Canyon Creek Watershed
Estimated Expected Values of
Dissolved Zinc Concentrations

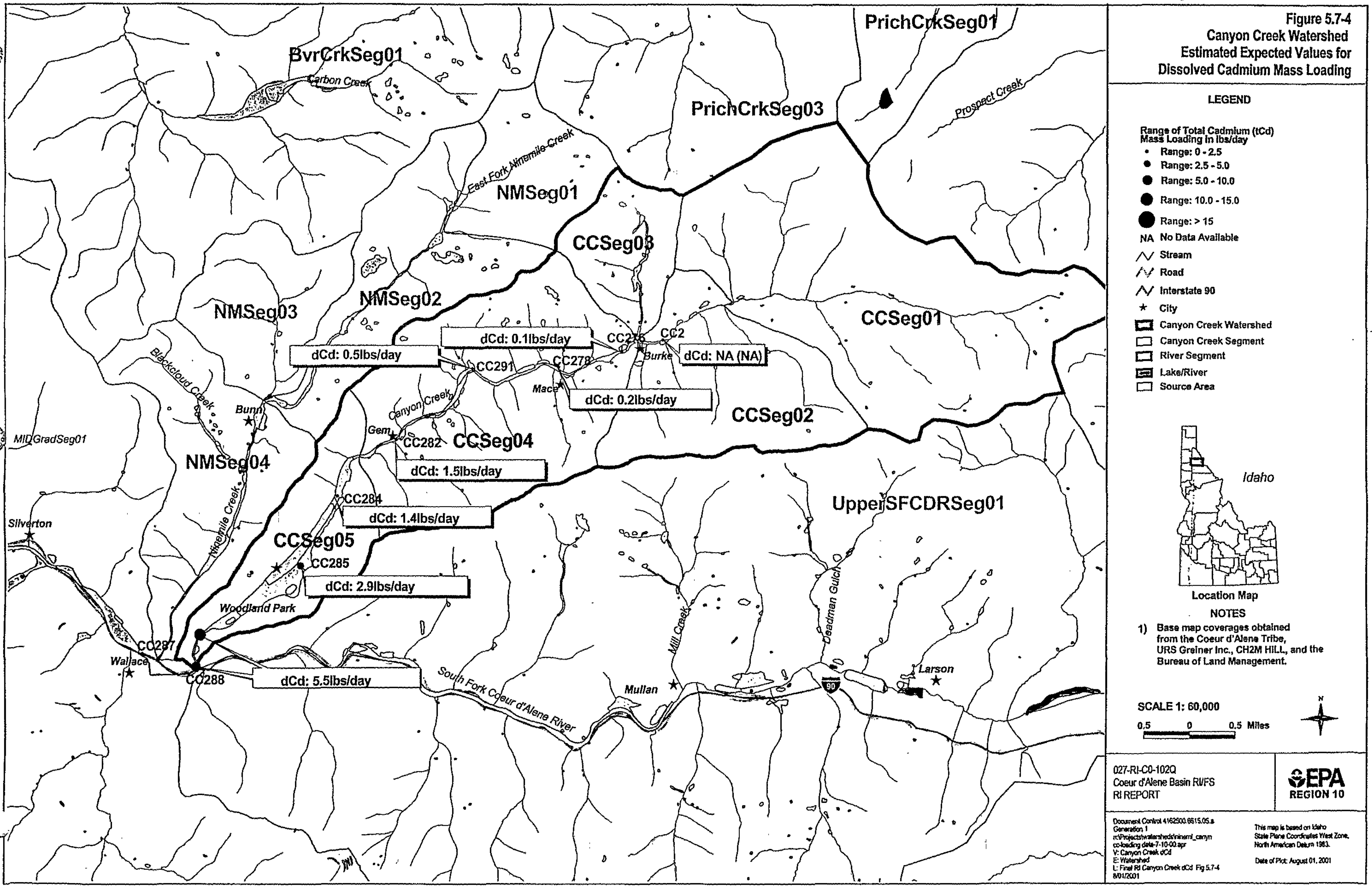


Figure 5.7-4
Canyon Creek Watershed
Estimated Expected Values for
Dissolved Cadmium Mass Loading

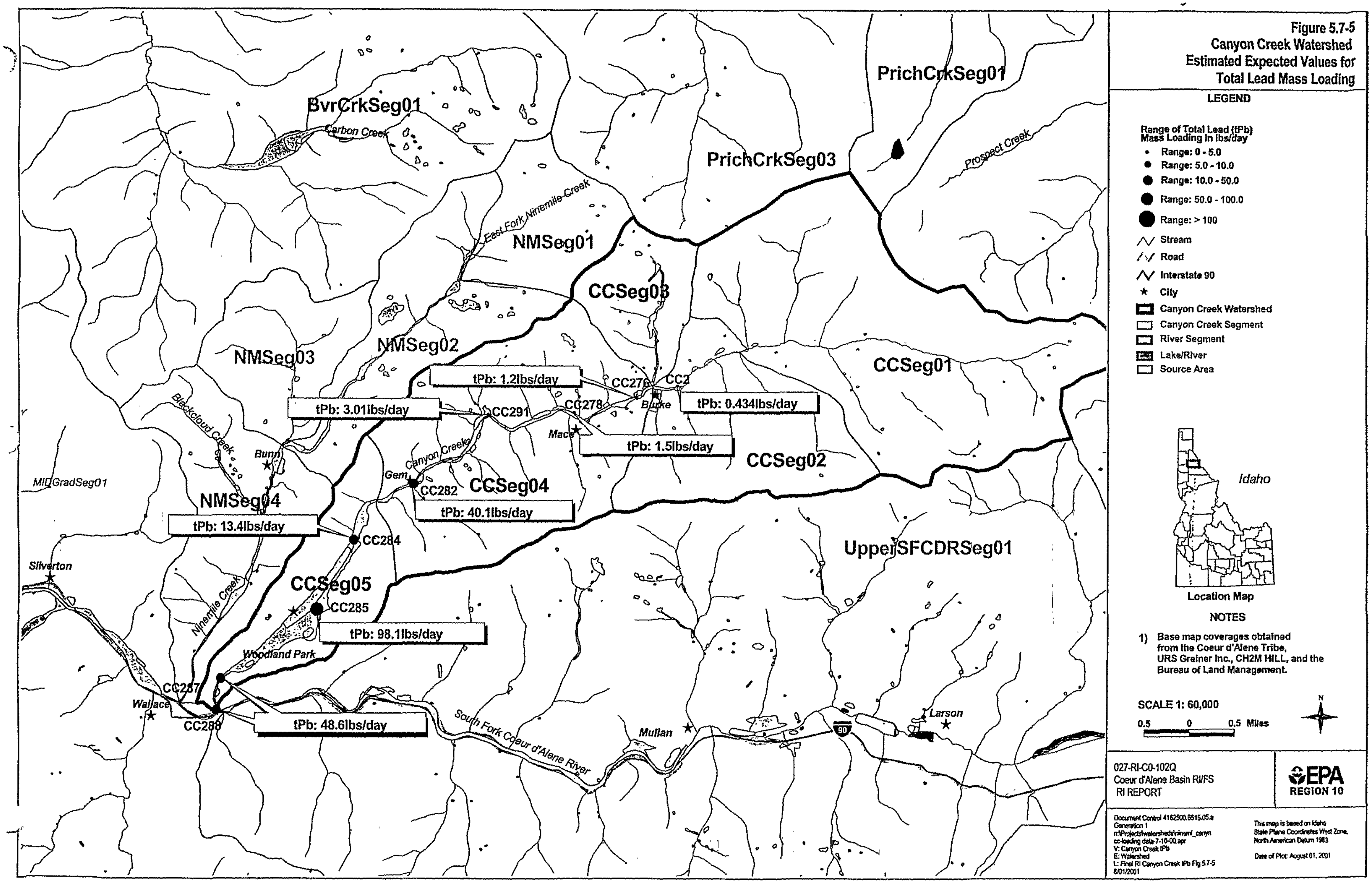


Figure 5.7-5
Canyon Creek Watershed
Estimated Expected Values for
Total Lead Mass Loading
LEGEND
Range of Total Lead (tPb)
Mass Loading in lbs/day
Range: 0 - 5.0
Range: 5.0 - 10.0
Range: 10.0 - 50.0
Range: 50.0 - 100.0
Range: > 100
Stream
Road
Interstate 90
City
Canyon Creek Watershed
Canyon Creek Segment
River Segment
Lake/River
Source Area
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.
SCALE 1: 60,000
0.5 0 0.5 Miles
027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
Document Control 4162500.6615.05.a
Generation 1
V: Canyon Creek tPb
E: Watershed
L: Final RI Canyon Creek tPb Fig 5.7-5
8/01/2001
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.
Date of Plot: August 01, 2001
BvrCrkSeg01
Carbon Creek
PrichCrkSeg01
PrichCrkSeg03
Prospect Creek
East Fork Ninemile Creek
NMSeg01
NMSeg02
NMSeg03
NMSeg04
CCSeg03
CCSeg01
CCSeg02
CCSeg04
CCSeg05
UpperSFCDRSeg01
MIDGradSeg01
tPb: 1.2lbs/day
tPb: 3.01lbs/day
tPb: 0.434lbs/day
tPb: 1.5lbs/day
tPb: 40.1lbs/day
tPb: 13.4lbs/day
tPb: 98.1lbs/day
tPb: 48.6lbs/day
CC276
CC278
CC291
CC282
CC284
CC285
CC287
CC288
Burke
Mace
Gem
Canyon Creek
Blackcloud Creek
Burn
Silverton
Ninemile Creek
Woodland Park
Wallace
South Fork Coeur d'Alene River
Mullan
Larson
90

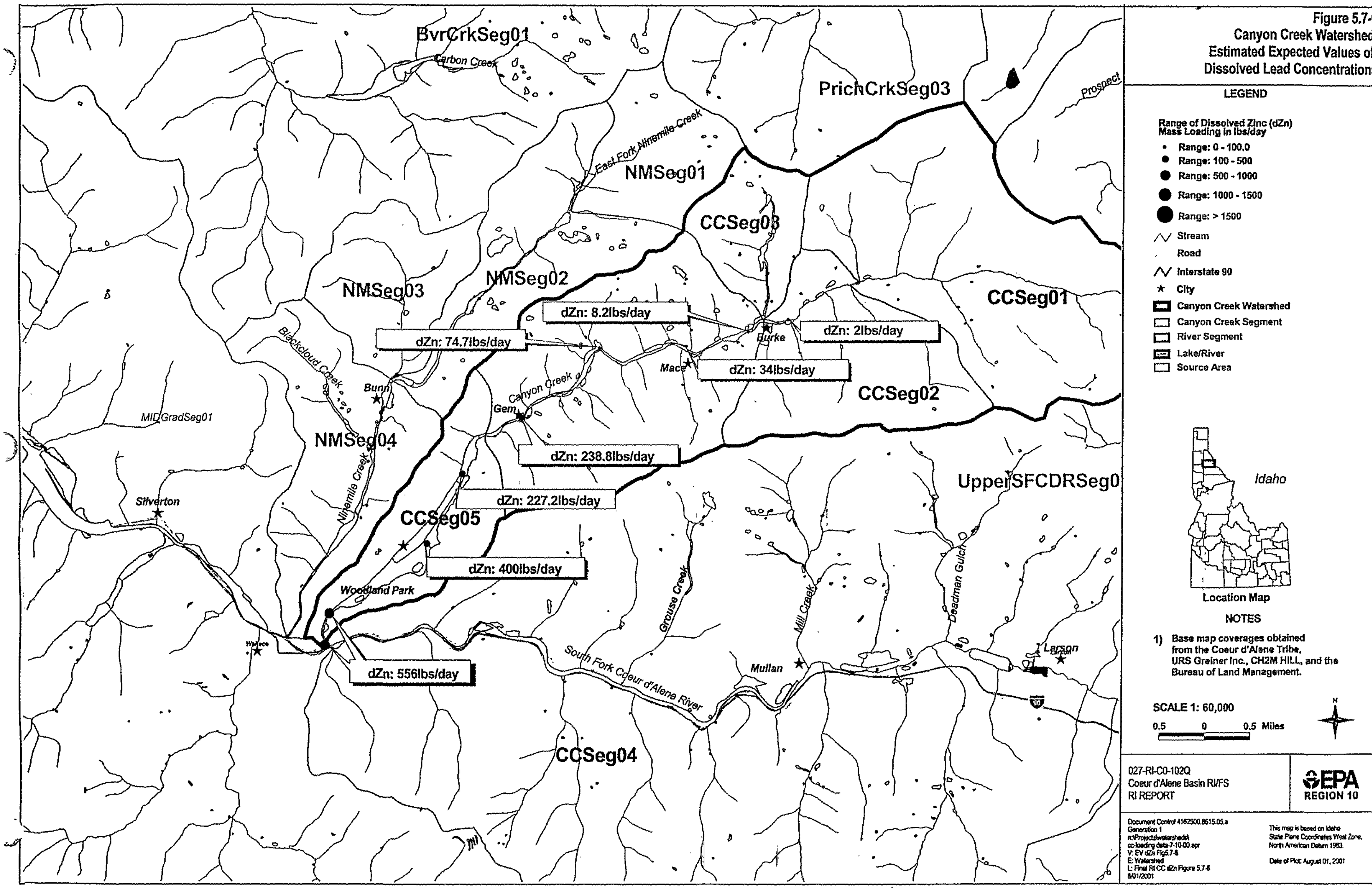
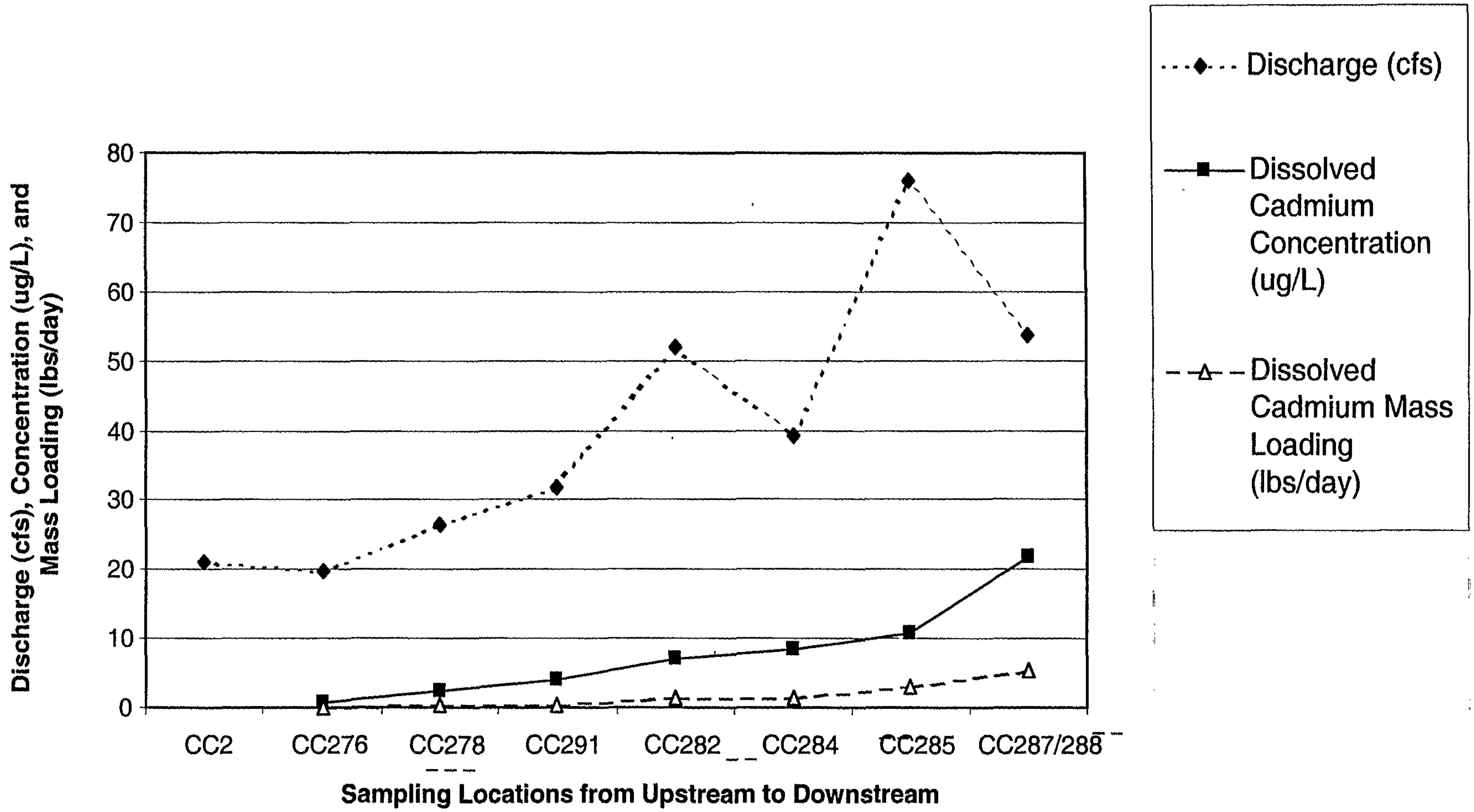
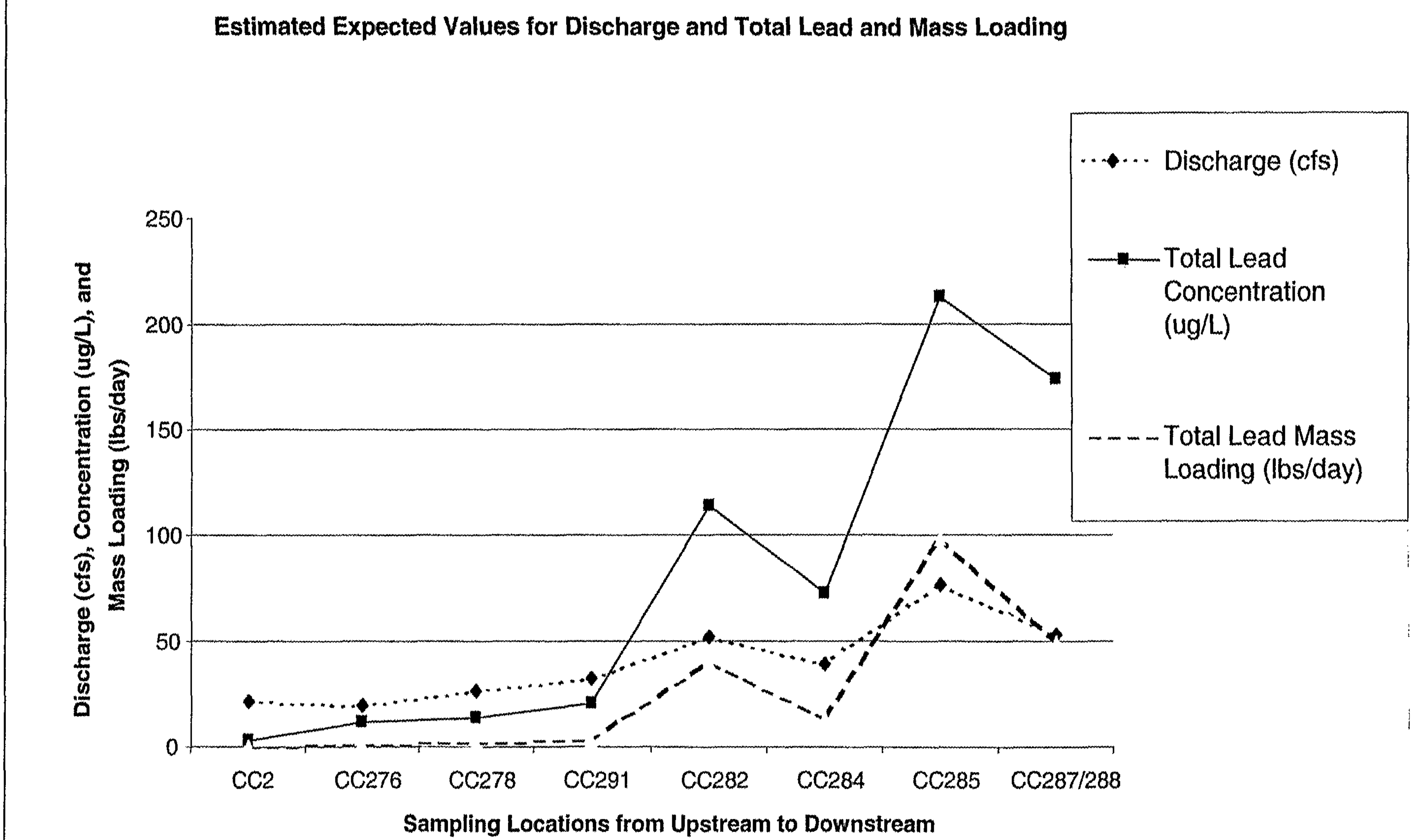


Figure 5.7-6
Canyon Creek Watershed
Estimated Expected Values of
Dissolved Lead Concentrations
LEGEND
Range of Dissolved Zinc (dZn) Mass Loading in lbs/day
Range: 0 - 100.0
Range: 100 - 500
Range: 500 - 1000
Range: 1000 - 1500
Range: > 1500
Stream
Road
Interstate 90
City
Canyon Creek Watershed
Canyon Creek Segment
River Segment
Lake/River
Source Area
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.
SCALE 1: 60,000
0.5
0
0.5 Miles
N
027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
Document Control 4162500.6615.05.a
Generation 1
n:\Projects\watersheds\
cc-loading data-7-10-00.apr
V: EV dZn Fig5.7-6
E: Watershed
L: Final RI CC dZn Figure 5.7-6
8/01/2001
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.
Date of Plot: August 01, 2001
BvrCrkSeg01
Carbon Creek
PrichCrkSeg03
Prospect
East Fork Ninemile Creek
NMSeg01
CCSeg03
NMSeg02
NMSeg03
CCSeg01
dZn: 8.2lbs/day
dZn: 2lbs/day
dZn: 74.7lbs/day
Burke
Blackcloud Creek
Mace
dZn: 34lbs/day
CCSeg02
Bunn
Canyon Creek
Gem
MIDGradSeg01
NMSeg04
dZn: 238.8lbs/day
Ninemile Creek
UpperSFCDRSeg0
Silverton
dZn: 227.2lbs/day
CCSeg05
dZn: 400lbs/day
Woodland Park
Grouse Creek
Mill Creek
Deadman Gulch
Wallace
dZn: 556lbs/day
South Fork Coeur d'Alene River
Mullan
Larson
90
CCSeg04

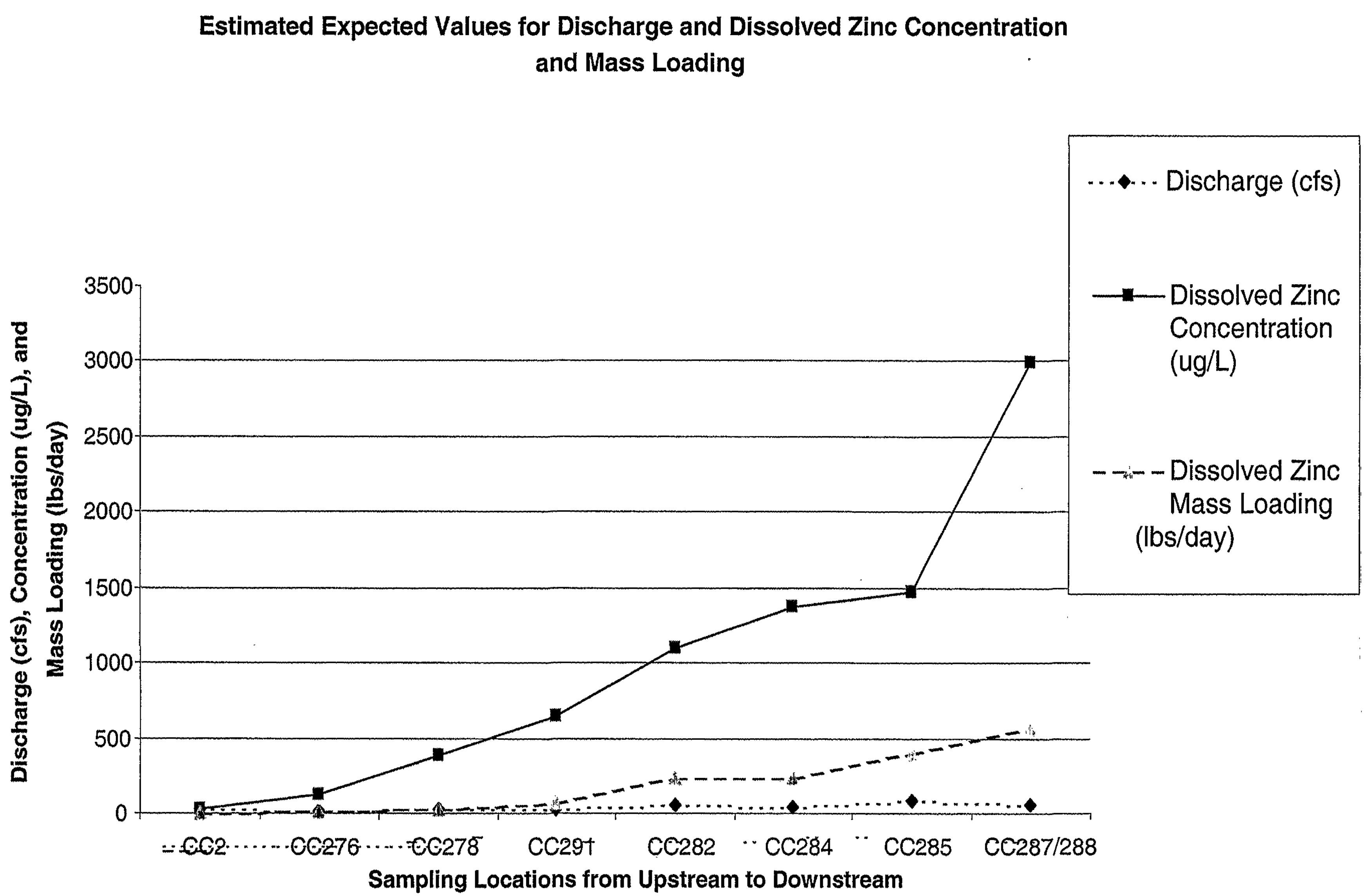
Estimated Expected Values of Discharge and Dissolved Cadmium Concentration and Mass Loading



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.7-7



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Canyon Creek Series 07/19/01	Figure 5.7-8



EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

Doc Control: 4162500.6615.05.a
Generation: 1

Canyon Creek Series
07/19/01

Figure 5.7-9

Table 5.5-1
Summary of Estimated Values for Discharge, Metals Concentrations, and Metals Mass Loading[a] in Canyon Creek

	Concentration (µg/L)			Mass Loading (pounds/day)			
Sampling Location	**Dissolved Cadmium**	**Total Lead**	**Dissolved Zinc**	**Dissolved Cadmium**	**Total Lead**	**Dissolved Zinc**	**Discharge (cfs)**
Screening Level or TDML[b,c]	0.38	15	42	0.297	0.478	25.9	NA
CC2	NA	3.21 (1.57)	26.2 (0.429)	NA	0.434 (4.08)	2.0 (0.612)	21.2 (1.56)
CC276	**0.68** (0.23)	11.9 (1.53)	**122.4** (1.41)	0.1 (0.73)	**1.2** (2.16)	8.2 (1.29)	19.6 (0.88)
CC278	**2.5** (0.67)	13.3 (0.4)	**378** (0.67)	0.2 (0.58)	**1.5** (0.83)	**34** (1.06)	26.3 (1.13)
CC291	**3.9** (0.51)	**20.4** (0.349)	**650** (0.65)	**0.5** (0.67)	**3.01** (1.04)	**74.7** (0.57)	31.9 (1.23)
CC282	**7.1** (0.55)	**114** (1.8)	**1099** (0.52)	**1.5** (0.71)	**40.1** (3.46)	**238.8** (0.77)	52 (0.96)
CC284	**8.4** (0.51)	72.6 (1.46)	**1368** (0.56)	**1.4** (0.81)	**13.4** (1.99)	**227.2** (0.70)	39 (2.68)
CC285	**10.8** (0.85)	**213** (2.45)	**1463** (0.8)	**2.9** (1.1)	**98.1** (5.08)	**400** (0.82)	76.0 (1.4)
CC287/288[d]	**21.9** (0.74)	**174** (1.99)	**2996** (0.71)	**5.5** (1.2)	**48.6** (3.14)	**556** (0.67)	53.4 (1.15)

[a] Summary tables with all modeling results are included in Appendix C.
[b] TMDLs are based on the 90th percentile.
[c] Dissolved mass loading value; the TMDL for total lead was obtained by multiplying a translator to convert to a total lead load as described in text.
[d]Values calculated from data combined for locations CC287 and CC288.
Values in parentheses are coefficients of variation.

Notes:
µg/L - micrograms per liter
cfs - cubic feet per second
bold - indicates exceedance of screening level or TMDL

Table 5.5-2
Estimated Gains or Losses in Discharge

Reach (Number of Samples)	Estimated Gain or Loss (in cfs)	Coefficient of Variation (CV) ($P_{xi,Xj} = 0.9$)
CC2 (36)and CC276	-1.6	11.9
CC276 (41) and CC278	6.7	2.4
CC278 (38) and CC291	5.60	3.2
CC291 (35) and CC282	20.1	1.1
CC282 (23) and CC284	-13	4.9
CC284 (42) and C 285	37	1.3
CC285 (38) and CC287/288	-22.6	2.6

Note:
cfs - cubic feet per second

Table 5.5-3
Estimated Gains or Losses for Dissolved Zinc Concentrations and Loads

Reach	Estimated Gain Or Loss In Concentration Of Dissolved Zinc (µg/L)	Estimated Coefficient Of Variation (CV) For Dissolved Zinc ($P_{xi,Xj}$ = 0.9)	Estimated Gain Or Loss In The Dissolved Zinc Load (Pounds/Day)	Estimated Coefficient Of Variation (CV) For Dissolved Zinc Load ($P_{xi,Xj}$ = 0.9)
CC2 (36) to CC276	96.2	1.7	6.2	1.5
CC276 (41) to CC278	255.6	0.5	25.8	1.0
CC278 (38) to CC291	272	0.8	40.7	0.5
CC291 (35) and CC282	449	0.6	164.1	0.9
CC282 (23) to CC284	269	1.3	-11.6	6.9
CC284 (42) to CC285	95	6.2	172.8	1.1
CC285 (38) to CC287/CC288	1,533	0.8	156	1.0

Note:
µg/L - micrograms per liter

Table 5.5-4
Estimated Gains or Losses for Total Lead Concentrations and Load

Reach	Estimated Gain Or Loss In Total Concentration Of Lead (µg/L)	Estimated Coefficient Of Variation (CV) For Total Lead Concentration	Estimated Gain Or Loss In The Total Lead Load (Pounds/Day)	Estimated Coefficient Of Variation (CV) For Total Lead Load
CC2 to CC276	8.69	1.6	0.766	1.6
CC276 to CC278	1.4	9.7	0.3	5.2
CC278 to CC291	7.1	0.5	1.51	1.4
CC291 to CC282	93.6	2.1	37.1	3.7
CC282 to CC284	-41:4	2.9	-26.7	4.3
CC284 to CC285	140.4	3.1	84.7	5.6
CC285 to CC287/288	-39	6.6	-49.5	7.4

Note:
µg/L - micrograms per liter

Table 5.5-5
Expected Gains or Losses for Dissolved Cadmium Concentrations and Loads

Reach	Expected Gain Or Loss In Dissolved Cadmium (µg/L)	Estimated Coefficient Of Variation (CV) For Dissolved Cadmium	Expected Gain Or Loss In Dissolved Cadmium Load (Pounds/Day)	Estimated Coefficient Of Variation (CV) For Dissolved Cadmium Load
CC276 to CC278	1.82	0.8	0.1	0.6
CC278 to CC291	1.40	0.6	0.3	0.8
CC291 to CC282	3.2	0.7	1.0	0.8
CC282 to CC284	1.3	1.4	-0.1	5.0
CC284 to CC285	2.4	2.4	1.5	1.5
CC285 to CC287/288	11.1	0.8	2.6	1.5

Note:
µg/L - micrograms per liter

Table 5.7-1
Estimated Gain or Loss of Dissolved Cadmium, Total Lead, and Dissolved Zinc Loads

Reach	Estimated Gain or Loss In Dissolved Cadmium Load (Pounds/Day)	Estimated Gain or Loss In Total Lead Load (Pounds/Day)	Estimated Gain or Loss In Dissolved Zinc Load (Pounds/Day)
CC2 to CC276	NA	0.766	6.2
CC276 to CC278	0.1	0.3	25.8
CC278 to CC291	0.3	1.51	40.7
CC291 to CC282	1.0	37.1	164.1
CC282 to CC284	-0.1	-26.7	-11.6
CC284 to CC285	1.5	84.7	172.8
CC285 to CC287/288	2.6	-49.5	156

NA - not available.

Table 5.7-2
Potential Major Source Areas in Canyon Creek Watershed

Reach	Location Description	Associated Source Areas
CC2 to CC276	Burke	Hercules No. 5 Tiger Poorman Mine
CC276 to CC278	Burke to Mace	Hecla-Star Mine and Mill Complex Hidden Treasure Mine
CC278 to CC291	Mace to Gem	Standard Mammoth No. 4 Standard-Mammoth Campbell Complex and Adit
CC291 to CC282	Gem	Frisco Millsite Black Bear Millsite Frisco No. 3 Black Bear No. 4 Black Bear Fraction Tamarack No. 7 (1200 Level)
CC282 to CC284	Gem to Upper Woodland Park	Canyon Creek Floodplain Gem Mill Site Gem No. 3
CC284 to CC285	Upper Woodland Park to Mid-Woodland Park	Hecla-Star Tailings Ponds Canyon Creek Impacted Floodplain and Riparian
CC285 to CC 287	Mid-Woodland Park to Lower Woodland Park	Canyon Creek Impacted Floodplain and Riparian
CC287 to CC288	Lower Woodland Park to South Fork Coeur d'Alene River	Canyon Creek Impacted Floodplain and Riparian

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ATTACHMENT 1
Data Source References

Data Source References

Data Source References[a]	Data Source Name	Data Source Description	Reference
2	URS FSPA Nos. 1, 2, and 3	Fall 1997: Low Flow and Sediment Sampling	URS Greiner Inc. 1997. Field Sampling Plan Addendum 1 Sediment Coring in the Lower Coeur d'Alene River Basin, Including Lateral Lakes and River Floodplains
			URS Greiner Inc. 1997. Field Sampling Plan Addendum 2 Adit Drainage, Seep and Creek Surface Water Sampling
			URS Greiner Inc. 1997. Field Sampling Plan Addendum 3 Sediment Sampling Survey in the South Fork of the Coeur d'Alene River, Canyon Creek, and Nine-Mile Creek
3	URS FSPA No. 4	Spring 1998: High Flow Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 4 Adit Drainage, Seep and Creek Surface Water Sampling; Spring 1998 High Flow Event
4	MFG Historical Data Spring 1991	Spring 1991: High Flow Sampling	McCulley, Frick & Gillman, Inc. 1991. Upstream Surface Water Sampling Program Spring 1991 High Flow Event, South Fork Coeur d'Alene River Basin above Bunker Hill Superfund Site: Tables 1 and 2
5	MFG Historical Data Fall 1991	Fall 1991: Low Flow Sampling	McCulley, Frick & Gillman, Inc. 1992. Upstream Surface Water Sampling Program Fall 1991 Low Flow Event, South Fork Coeur d'Alene River Basin above Bunker Hill Superfund Site: Tables 1 and 2
6	EPA/Box Historical Data	Superfund Site Groundwater and Surface Water Data	CH2MHill. 1997. Location of Wells and Surface Water Sites, Bunker Hill Superfund Site. Fax Transmission of Map August 11, 1998
			Environmental Protection Agency. 1998. E-mail from Ben Cope July 15, 1998. Subject: 2 Datasets File Attached: BOXDATA.WK4
7	IDEQ Historical Data	IDEQ Water Quality Data	Idaho Department of Environmental Quality. 1998. Assortment of files from Glen Pettit for water years 1993 through 1996
			Idaho Department of Environmental Quality. 1998. E-mail from Glen Pettit October 6, 1998 Subject: DEQ Water Quality Data Files Attached: 1998 trend Samples.xls, 1997 trend Samples.xls

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
8	EPA/NPDES Historical Data	Water Quality based on NPDES Program	Environmental Protection Agency. 1998. E-mail from Ben Cope August 11, 1998/September 2, 1998. Subject: Better PCS Data Files/Smelterville. Attached: PCS2.WK4, PCSREQ.698/TMT-PLAN.XLS
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			Environmental Protection Agency. 1998. E-mail from Ben Cope July 15, 1998. Subject: 2 Datasets File Attached: PCSDATA.WK4
10	URS FSPA No. 5	Common Use Areas Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 5 Common Use Areas: Upland Common Use Areas and Lower Basin Recreational Beaches; Sediment/Soil, Surface Water, and Drinking Water Supply Characterization
11	URS FSPA No. 8	Source Area Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 8 Tier 2 Source Area Characterization Field Sampling Plan
12	Historical Groundwater Data from MFG	1997 Annual Groundwater Data Report Woodland Park	McCulley, Frick & Gillman. 1998. 1997 Annual Groundwater Data Report Woodland Park
13	Historical Data from US Forest Service, Idaho Geological Survey and others	Historical Data on Inactive Mine Sites USFS, IGS and CCJM, 1994-1997, Prichard Creek, Pine Creek and Summit Mining District	Mackey K, Yarbrough, S.L. 1995. Draft Removal Preliminary Assessment Report Pine Creek Millsites, Coeur d'Alene District, Idaho, Contract No. 1422-N651-C4-3049
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. I, Prichard Creek and Eagle Creek Drainages
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. III, Coeur d'Alene River Drainage Surrounding the Coeur d'Alene Mining District (Excluding the Prichard Creek and Eagle Creek Drainages)
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. IV, Prichard Creek and Eagle Creek Drainages

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
13	Historical Data from US Forest Service, Idaho Geological Survey and others (continued)		Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. V, Coeur d'Alene River Drainage Surrounding the Coeur d'Alene Mining District (Excluding the Prichard Creek and Eagle Creek Drainages) Part 2 Secondary Properties
			US Forest Service. 1995. Pilot Inventory of Inactive and Abandoned Mine Lands, East Fork Pine Creek Watershed, Shoshone County, Idaho
14	Historical Sediment Core Data: University of Idaho (Thesis papers)	Historical Lateral Lakes Sediment Data from F. Rabbi and M.L. Hoffman	Characterization of Heavy Metal Contamination in Two Lateral Lakes of the Lower Coeur d'Alene River Valley, A thesis by M.L. Hoffmann, May 1995
			Trace Element Geochemistry of Bottom Sediments and Waters from the Lateral Lakes of Coeur d'Alene River, A Dissertation by F. Rabbi, May 1994
15	URS FSPA No. 9	Source Area Characterization; Field XRF Data	CH2M Hill and URS Greiner. 1998. Field Sampling Plan Addendum 9 Delineation of Contaminant Source Areas in the Coeur d'Alene Basin using Survey and Hyperspectral Imaging Techniques
16	Historical Sediment Data	Electronic Data compiled by USGS	U.S. Geological Survey. 1992. Effect of Mining-Related Activities on the Sediment-Trace Element Geochemistry of Lake Coeue d'Alene, Idaho, USA--Part 1: Surface Sediments, USGS Open-File Report 92-109, Prepared by A.J. Horowitz, K.A. Elrick, and R.B. Cook
			US Geological Survey. 2000. Chemical Analyses of Metal-Enriched Sediments, Coeur d'Alene Drainage Basin, Idaho: Sampling, Analytical Methods, and Results. Draft. October 13, 2000. Prepared by S.E. Box, A.A. Bookstrom, M. Ikramuddin, and J. Lindsey. Samples collected from 1993 to 1998.

Data Source References (Continued)

Data Source References*	Data Source Name	Data Source Description	Reference
17	USGS Spokane River Basin Sediment Samples	Surface Sediment Samples Collected by USGS in the Spokane River Basin	Environmental Protection Agency. 1999. Data Validation Memorandum and Attached Table from Laura Castrilli to Mary Jane Nearman dated June 9, 1999. Subject: Coeur d'Alene (Bunker Hill) Spokane River Basin Surface Sample Samples, USGS Metals Analysis, <63 um fraction, Data Validation, Samples SRH7-SRH30
18	USGS Snomelt Surface Water Data	Surface Water Data from 1999 Snomelt Runoff Hydrograph	USGS. 1999. USGS WY99.xls Spreadsheet dowloaded from USGS (Coeur d'Alene Office) ftp site
			USGS. 2000. Concentrations and Loads of Cadmium, Lead and Zinc Measured near the Peak of the 1999 Snomelt Runoff Hydrograph at 42 Stations, Coeur d'Alene River Basin Idaho
			USGS. 2000. Concentrations and Loads of Cadmium, Lead and Zinc Measured on the Ascending and Descending Limbs of the 1999 Snomelt Runoff Hydrograph at Nine Stations, Coeur d'Alene River Basin Idaho
22	MFG Report on Union Pacific Railroad Right-of-Way Soil Sampling	Surface and Subsurface Soil Lead Data	MFG. 1997. Union Pacific Railroad Wallace Branch, Rails to Trails Conversion, Right-of-Way Soil Sampling, Summary and Interpretation of Data. McCulley, Frick and Gilman, Inc. March 14, 1997
23	URS FSPA No. 11A	Source Area Groundwater and Surface Water Sampling	URS Greiner Inc. 1999. Field Sampling Plan Addendum 11A Tier 2 Source Area Characterization
24	URS FSPA No. 15	Common Use Area Sampling—Spokane River	URS Greiner Inc. 1999. Field Sampling Plan Addendum 15 Spokane River - Washington State Common Use Area Sediment Characterization
25	URS FSPA No. 18	Depositional and Common Use Area Sediment Sampling - Spokane River	URS Greiner Inc. 2001. Final Field Sampling Plan Addendum No. 18, Fall 2000 Field Screening of Sediment in Spokane River Depositional Areas, Summary of Results. Revision 1. January 2001
28	USGS National Water Quality Assessment database	Surface water data for sampling location NF50 at Enaville, Idaho	USGS. 2001. USGS National Water Quality Assessment database: http://infotrek.er.usgs.gov/pls/nawqa/nawqa.wwv_main.gohome. Data retrieved on August 2, 2001 for station 12413000, NF Coeur d'Alene River at Enaville, Idaho

*Reference Number is the sequential number used as cross reference to associate chemical results in data summary tables with specific data collection efforts.

ATTACHMENT 2
Data Summary Tables

ABBREVIATIONS USED IN DATA SUMMARY TABLE

LOCATION TYPES:

AD adit
BH borehole
FP flood plain
GS ground surface/near surface
HA hand auger boring
LK lake/pond/open reservoir
OF outfall/discharge
RV river/stream
SP stockpile
TL tailings pile

QUALIFIERS:

U Analyte was not detected above the reported detection limit
J Estimated concentration

DATA SOURCE REFERENCES:

Data source references listed in Attachment 1 are shown in the data summary tables in the "Ref" column.

Data Summary Table
Canyon Creek - segment CCSeg01

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC272	RV	2	11/10/1997		0.19 U	0.16 U	0.069 U	1.7 J	5 U	0.79	1 U	0.1 U	0.22 U	13.3 U
CC289	RV	3	05/15/1998		0.5 U	1 U	0.1 U	3 U	22.4 U	0.5	5 U	0.2 U	0.3 U	6.2
CC802	OF	8	03/24/1998		45 U	40 U	2 U	3 U		25 U	2	0.2 U	4 U	5.4
CC8226	AD	13	—			29 U	3 U	35 U	12 U	15 U	2 U	5 U		3 U
CC8227	AD	13	—			29 U	3 U	35 U	22	15 U	2 U	5 U		3 U
CC8228	AD	13	—			29 U	3 U	41	12 U	15 U	2 U	5 U		32
CC8251	AD	13	—			29 U	4	35 U	12 U	6.5	4	5 U		3 U
Surface Water - Dissolved Metals (ug/l)														
CC272	RV	2	11/10/1997		0.5 U	0.1 U	0.04 U	1.5	10 U	0.58	1 U	0.2 U	0.03 U	10.1
CC289	RV	3	05/15/1998		0.5 U	1 U	0.1 U	3 U	20 U	0.5 U	5 U	0.2 U	0.3 U	5.4
CC8226	AD	13	—				2.3 U	8 U	4.1		2			2.5 U
CC8227	AD	13	—				2.3 U	8 U	4.2		2 U			2.5 U
CC8228	AD	13	—				2.3 U	8 U	3.7 U		2			2.5 U
CC8251	AD	13	—				2.3 U	8 U	3.7 U		6			2.5 U

Data Summary Table
Canyon Creek - segment CCSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
CC11190	FP	16	---			11.1	4	73.1	17300	922	999			642
CC11191	FP	16	---			9.1	6.5	52.8	15400	1040	681			917
CC11192	FP	16	---			9.6	1.4	23.2	11800	445	1310			424
CC1243	GS	15	10/03/1998				0.276		4430					5.09
CC1244	GS	15	10/10/1998				1.51			32.5				127
CC1245	GS	15	10/10/1998				0.522		2660					29.3
CC1246	GS	15	10/10/1998				16.7		43800	1150				1620
CC1247	GS	15	10/10/1998				1.24		12000	6.49				99.9
CC1248	GS	15	10/10/1998				0.399		8010					17.2
CC1249	GS	15	10/10/1998						17600					
CC1251	GS	15	10/10/1998				0.433							20.4
CC1252	GS	15	10/13/1998				8.75		238000	2550				837
CC1293	GS	15	10/02/1998				1.62		120000					137
CC8285	TL	13	---			85 U	1.6	59	18000	63	1200			39
Subsurface Soil (mg/kg)														
CC402	MW	11	10/27/1998	5	38.6	24.5 J	12.5 J	97.9 J	16200 J	12400	980 J	2.1	24.4 J	3220
CC402	MW	11	10/27/1998	10	1.4 U	32.9 J	1.2 J	14.4 J	10000 J	90.5	101 J	0.06 UJ	0.98 UJ	507
CC402	MW	11	10/27/1998	25	1.2 U	13.2 J	0.35 UJ	19.8 J	15800 J	23.6	534 J	0.06 UJ	0.44 UJ	59.3
Sediment (mg/kg)														
CC1250	GS	15	10/12/1998				2.85		12000	304				257
CC707	TP	2	01/16/1998	0.5	1.1 J	3.6	0.52 J	25.5	11600	88	428	0.13	347 J	220
CC708	TP	2	01/16/1998	0	1.7 J	4.5			11700	160	665	0.09 U		162
CC708	TP	2	01/16/1998	0			0.65 J	32.5					0.57 J	
Groundwater - Total Metals (ug/l)														
CC402	MW	11	12/03/1998	20	1.6 J	2.2	3 J	0.51 J	6.9 U	0.44 J	3.4 U	0.2 U	4.5 U	610
CC402	MW	23	12/05/1999	20	2 U	4.5	0.5 U	5 U	25 U	0.5 U	5 U	0.2 U	5 U	5 U
Groundwater - Dissolved Metals (ug/l)														
CC402	MW	11	12/03/1998	20	0.93 J	2	2.9 J	0.087 U	21.5 U	0.13 J	4.6 U	0.2 U	4.5 U	510 J
CC402	MW	23	12/05/1999	20	2 U	4.2	0.5 U	5 U	25 U	0.5 U	5 U	0.2 U	5 U	5 U

Data Summary Table
Canyon Creek - segment CCSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X
	Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC1	RV	4	05/17/1991				0.1 U			3 U				200
CC1	RV	5	10/05/1991				0.2 U			1				12 U
CC2	RV	4	05/18/1991				0.1			8				200
CC2	RV	5	10/05/1991				0.2 U							22
CC2	RV	5	10/05/1991							2				
CC2	RV	7	10/27/1993				0.25 U			2.5 U				20.5
CC2	RV	7	11/30/1993				0.25 U			7				22.8
CC2	RV	7	12/17/1993				0.25 U			11				27.4
CC2	RV	7	01/20/1994				0.25 U			2.5 U				34.2
CC2	RV	7	02/18/1994				0.25 U			2.5 U				28
CC2	RV	7	03/08/1994				0.25 U			2.5 U				28
CC2	RV	7	03/23/1994				0.25 U			2.5 U				14
CC2	RV	7	04/07/1994				0.25 U			5 J				22
CC2	RV	7	04/19/1994				0.25 U			7				18
CC2	RV	7	05/04/1994				0.25 U			2.5 U				19
CC2	RV	7	05/19/1994				0.25 U			2.5 U				16
CC2	RV	7	06/08/1994				0.25 U			2.5 U				17
CC2	RV	7	06/23/1994				0.25 U			2.5 U				35
CC2	RV	7	07/25/1994				0.25 U			2.5 U				16
CC2	RV	7	08/16/1994				0.7			2.5 U				29
CC2	RV	7	09/13/1994				0.25 U			2.5 U				23
CC2	RV	7	10/06/1994				0.25 U			6				24
CC2	RV	7	11/16/1994				0.25 U			5 J				18
CC2	RV	7	12/13/1994				0.25 U			2.5 U				36
CC2	RV	7	01/10/1995				0.25 U			2.5 U				29
CC2	RV	7	02/09/1995				0.25 U			2.5 U				31
CC2	RV	7	03/08/1995				0.25 U			2.5 U				23
CC2	RV	7	03/22/1995				0.25 U			2.5 U				26
CC2	RV	7	04/12/1995				0.25 U			2.5 U				31
CC2	RV	7	04/25/1995				0.25 U			6				20
CC2	RV	7	05/10/1995				0.6			5 J				23
CC2	RV	7	05/23/1995				1.2			7				16
CC2	RV	7	06/13/1995				0.5 J			6				20
CC2	RV	7	06/27/1995				0.25 U			2.5 U				31
CC2	RV	7	07/11/1995				0.25 U			2.5 U				23
CC2	RV	7	07/25/1995				[illegible]			2.5 U				45
CC2	RV	7	08/14/1995				0.25 U			2.5 U				19

Data Summary Table
Canyon Creek - segment CCSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC2	RV	7	09/13/1995				0.25 U			2.5 U				25
CC273	RV	2	11/10/1997			0.16 U	0.069 U					0.1 U	0.22 U	11.4 U
CC273	RV	2	11/10/1997		0.16 U			0.96 J	6.7 J	0.45 J	2 J			
CC273	RV	3	05/15/1998		0.5 U	1 U	0.1 U	3 U	20 U	1	5 U	0.2 U	0.3 U	5 U
CC274	RV	2	11/10/1997		0.18 U	0.16 U	0.069 U	0.42 U	58.1 J	0.44 J	1 U	0.1 U	0.22 U	23.5 U
CC274	RV	18	10/27/1998				1 UJ			1 UJ				10
CC274	RV	18	11/18/1998				1 UJ			1				10
CC274	RV	18	12/15/1998				1 UJ			1				20
CC274	RV	18	12/15/1998				1 UJ			1				20
CC274	RV	18	01/20/1999				1 UJ			1				10
CC274	RV	18	03/22/1999				1 UJ			1				40
CC274	RV	18	04/21/1999				1			1				40
CC274	RV	18	05/05/1999											10
CC274	RV	18	05/24/1999				1 U		60	5	8			10
CC274	RV	18	06/15/1999							4				
CC274	RV	18	07/08/1999				0.1 U			1.1				4.6
CC274	RV	18	08/05/1999				0.1 U			0.62				5.5
CC274	RV	18	08/30/1999				0.1 U			0.24				4.6
CC290	RV	3	05/15/1998		0.5 U	1 U	0.1 U	3 U	20 U	0.5 U	5 U	0.2 U	0.3 U	6.4
CC410	RV	11	11/12/1998		0.22 U	0.2 U	0.079 U	0.087 U	6.9 U	0.29 J	1.5 U	0.2 U	4.5 U	9.1
CC410	RV	23	12/05/1999		2 U	1 U	0.5 U	5 U	25 U	0.55 J	5 U	0.2 U	5 U	13.4
Surface Water - Dissolved Metals (ug/l)														
CC1	RV	4	05/17/1991				0.1			3 U				20 U
CC1	RV	5	10/05/1991				0.2 U			1 U				12 U
CC2	RV	4	05/18/1991				0.1			3 U				20 U
CC2	RV	5	10/05/1991				0.2 U			1 U				12 U
CC2	RV	7	10/27/1993				0.25 U			1.5 U				21.7
CC2	RV	7	11/30/1993				0.25 U			1.5 U				25.1
CC2	RV	7	12/17/1993				0.25 U			1.5 U				21.7
CC2	RV	7	01/20/1994				0.25 U			1.5 U				22.8
CC2	RV	7	02/18/1994				0.25 U			1.5 U				36
CC2	RV	7	03/08/1994				0.25 U			1.3 U				36
CC2	RV	7	03/23/1994				0.25 U			1.5 U				17
CC2	RV	7	04/07/1994				0.25 U			1.5 U				26
CC2	RV	7	04/19/1994				0.25 U			1.5 U				27
CC2	RV	7	05/04/1994				0.25 U			1.5 U				22

Data Summary Table
Canyon Creek - segment CCSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC2	RV	7	05/19/1994				0.25 U			1.5 U				13
CC2	RV	7	06/08/1994				0.25 U			1.5 U				27
CC2	RV	7	06/23/1994				0.25 U			3 J				35
CC2	RV	7	07/25/1994				0.25 U			1.5 U				28
CC2	RV	7	08/16/1994				0.25 U			2.5 J				37
CC2	RV	7	09/13/1994				0.25 U			1.5 U				29
CC2	RV	7	10/06/1994				0.25 U			1.5 U				16
CC2	RV	7	11/16/1994				0.25 U			1.5 U				17
CC2	RV	7	12/13/1994				0.25 U			1.5 U				40
CC2	RV	7	01/10/1995				1.3			1.5 U				28
CC2	RV	7	02/09/1995				0.25 U			1.5 U				52
CC2	RV	7	03/08/1995				0.25 U			1.5 U				26
CC2	RV	7	03/22/1995				0.25 U			1.5 U				21
CC2	RV	7	04/12/1995				0.25 U			1.5 U				21
CC2	RV	7	04/25/1995				0.25 U			1.5 U				12
CC2	RV	7	05/10/1995				0.6			3 J				21
CC2	RV	7	05/23/1995				1			3 J				10
CC2	RV	7	06/13/1995				0.5 J			3 J				12
CC2	RV	7	06/27/1995				0.25 U			1.5 U				31
CC2	RV	7	07/11/1995				0.25 U			3 J				26
CC2	RV	7	07/25/1995				0.25 U			1.5 U				42
CC2	RV	7	08/14/1995				0.25 U			1.5 U				28
CC2	RV	7	09/13/1995				0.25 U			1.5 U				23
CC273	RV	2	11/10/1997		0.5 U	0.1 U	0.04 U	0.5 U	10 U		1 U	0.2 U	0.03 U	
CC273	RV	2	11/10/1997							0.12				9.75
CC273	RV	3	05/15/1998		0.5 U	1 U	0.1 U	3 U	20 U	0.5 U	5 U	0.2 U	0.3 U	5 U
CC274	RV	2	11/10/1997		0.5 U	0.1 U	0.043	0.5 U	10 U	0.22	1 U	0.2 U	0.03 U	20.3
CC274	RV	18	10/27/1998				1 UJ			1 UJ				20
CC274	RV	18	11/18/1998				1 UJ			1 UJ				11 UJ
CC274	RV	18	12/15/1998				1 UJ			1 UJ				20
CC274	RV	18	12/15/1998				1 UJ			1 UJ				20
CC274	RV	18	01/20/1999				1 UJ			1 UJ				16
CC274	RV	18	03/22/1999				1 UJ			1 UJ				8.2 UJ
CC274	RV	18	04/21/1999				1 UJ			1.3				11 UJ
CC274	RV	18	05/05/1999				1 UJ			1				8.5
CC274	RV	18	05/24/1999				1 U		10 U	1 U	1 U			4.5
CC274	RV	18	06/15/1999				1 UJ			1				3

Data Summary Table
Canyon Creek - segment CCSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC274	RV	18	07/08/1999				1 U			1 U				5
CC274	RV	18	08/05/1999				1 U			1 U				5
CC274	RV	18	08/30/1999				1 U			1 U				5
CC290	RV	3	05/15/1998		0.5 U	1 U	0.1 U	3 U	20 U	0.5 U	5 U	0.2 U	0.3 U	5.8
CC410	RV	11	11/12/1998		0.31 U	0.2 U	0.11 UJ	0.087 U	20 U	0.19 U	1.5 U	0.2 U	4.5 U	10.6
CC410	RV	23	12/05/1999		2 U	1 U	0.5 U	5 U	25 U	0.5 U	5 U	0.2 U	5 U	12.8

Data Summary Table
Canyon Creek - segment CCSeg03

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
CC1285	GS	15	10/12/1998				5.86	334	159000	1450				553
CC1286	GS	15	10/11/1998				0.844		16600	63.4				60.8
CC1287	GS	15	10/11/1998				0.668		31400	280				43.5
CC1288	GS	15	10/11/1998				2.08	5.65	19100	8560				182
CC1289	GS	15	10/11/1998				42.9	159	154000	15000				8780
CC1290	GS	15	10/11/1998				1.25		38900	263				101
CC1291	GS	15	10/11/1998				2.54		32800	2200				228
CC1292	GS	15	10/11/1998				1.38		53100	148				113
CC1294	GS	15	10/10/1998				0.327		20400	59.4				10.1
CC1294	GS	15	10/11/1998				17.8	36.4	32500	10900				1720
CC1295	GS	15	10/11/1998				0.0799		25500					
CC1296	GS	15	10/11/1998				1.87		2490	36.1				162
Groundwater - Total Metals (ug/l)														
CC401	MW	11	12/04/1998	21	18	0.28 J	0.34 J	0.94 U	97.7 J	9.8	10.5	0.33	4.5 U	35.7
CC401	MW	23	12/06/1999	21	12.1	1 U	0.5 U	5 U	163 U	27.1	7.5 J	0.2 U	5 U	32.8
Groundwater - Dissolved Metals (ug/l)														
CC401	MW	11	12/04/1998	21	18.2	0.43 J	0.39 J	0.89 UJ	6.9 U	2.6	2.3 J	0.2 U	4.5 U	33.2
CC401	MW	23	12/06/1999	21	11.3	1 U	0.5 U	5 U	25 U	9.2	5 U	0.49	5 U	28.4
Surface Water - Total Metals (ug/l)														
CC392	RV	4	05/18/1991				1.4			232				165
CC392	RV	5	10/05/1991				1.4			24				98
CC392	RV	3	05/15/1998		5.2	2	2	3 U	85.5 U	27.4	81.1	0.2 U	0.3 U	180
CC392	RV	11	11/12/1998		85.1	1.5 J	1.8	5 U	50 U	27.5	5 U	0.2 U	5 U	140
CC392	RV	23	12/06/1999		38.7	1.1 J	1.7	5 U	25 U	19	5 U	0.2 U	5 U	141
CC8229	AD	13	—				3 U	35 U	260		150			210
Surface Water - Dissolved Metals (ug/l)														
CC392	RV	4	05/18/1991				0.3			3 U				54
CC392	RV	5	10/05/1991				1.3			4				12 U
CC392	RV	3	05/15/1998		5.2	1 U	1.9	3 U	20 U	11.7	76.9	0.2 U	0.3 U	172
CC392	RV	11	11/12/1998		81.5	1 U	1.7	5 U	50 U	26.9	5 U	0.2 U	5 U	129
CC392	RV	23	12/06/1999		38.1	1.2 J	1.7	5 U	25 U	16.8	5 U	0.2 U	5 U	131

Data Summary Table
Canyon Creek - segment CCSeg03

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC8229	AD	13	—				2.3 U	10	250		140			180

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
CC1253	GS	15	10/10/1998				29.8		35936.1372	4880				2900
CC1254	GS	15	10/10/1998				0.0308	567	134000	230				
CC1255	GS	15	10/10/1998						5380					
CC1261	GS	15	10/10/1998				4.96		21100	1660				464
CC1266	GS	15	10/13/1998				36	397	137000	7540				7180
CC1267	GS	15	10/10/1998				17.5	108	58100	10200				1700
CC1271	GS	15	10/11/1998				15.5		151000	1850				1500
CC1272	GS	15	10/12/1998					25	16100	4540				18800
CC1273	GS	15	10/11/1998				20.8		54200	1630				2020
CC1274	GS	15	10/11/1998				0.682		30500	207				45
CC1275	GS	15	10/12/1998				1.96		8090	1170				170
CC1276	GS	15	10/12/1998				0.772		50100	101				53.8
CC1277	GS	15	10/12/1998				15.1		33400	* 18500				1460
CC1278	GS	15	10/12/1998				1.73		18200	651				148
CC1279	GS	15	10/12/1998				24	118	31200	1540				2330
CC1280	GS	15	10/12/1998				50	1050	225000	* 29800				10400
CC1281	GS	15	10/12/1998				17.8		94200	1420				1730
CC1282	GS	15	10/12/1998				5.23		95400	1750				491
CC1283	GS	15	10/12/1998				1.02		18200	3100				77.9
CC1284	GS	15	10/12/1998				6.71		27100	1490				637
CC1298	GS	15	10/12/1998				12.5	1220	9540	* 29200				1200
CC1299	GS	15	10/12/1998				0.0679		13900					
CC1300	GS	15	10/12/1998				2.94		37700	11000				266
CC1301	GS	15	10/12/1998				23.7	70	32100	5060				2310
CC1302	GS	15	10/12/1998				6.94	421	2270	* 18300				659
CC1303	GS	15	10/12/1998				4.49	79.4	118000	* 24800				419
CC1304	GS	15	10/12/1998						57900	520				
CC1305	GS	15	10/12/1998				4.67	17.4	87400	16600				437
CC1306	GS	15	10/11/1998				0.0365		9050	43.4				
CC1308	GS	15	10/11/1998				22.4	676	46600	13400				2170
CC1309	GS	15	10/11/1998				3.99	140	31600	8940				370
CC1310	GS	15	10/11/1998				3.64	393	185000	* 18100				335
CC1311	GS	15	10/11/1998				3.99		15900	192				369
CC1314	GS	15	10/04/1998				2.07		19000	120				181
CC1315	GS	15	10/04/1998				0.238		4340					1.4
CC1316	GS	15	10/12/1998				0.4		12900	217				17.3
CC1317	GS	15	10/12/1998				1.71	16.3	20300	35.1				146

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
CC1318	GS	15	10/12/1998				0.203		15300	1.78				
CC1319	GS	15	10/12/1998				9.77		115000	104				936
CC1320	GS	15	10/12/1998				4.91		16900	333				460
CC1321	GS	15	10/04/1998				1.15		31200					90.7
CC1322	GS	15	10/04/1998				0.0255		9220					
CC1331	GS	15	10/13/1998				0.65		8540	15.3				41.8
CC1333	GS	15	10/04/1998				1.57		15000	182				132
CC1334	GS	15	10/04/1998				0.473		7030					24.4
CC1335	GS	15	10/04/1998				1.43		10600					118
CC1336	GS	15	10/05/1998				0.551		11200					32
CC1352	GS	15	10/04/1998				3.02		16800	296				275
CC1369	GS	15	10/12/1998				0.41		12300	46.4				18.3
CC1370	GS	15	10/12/1998				3.42		28800	1230				314
CC1371	GS	15	10/12/1998				6.71		23800	845				636
CC1372	GS	15	10/12/1998				6.36		17900	964				602
CC1373	GS	15	10/12/1998				16.5		10900	367				1590
CC1374	GS	15	10/12/1998					207	209000	1810				20700
CC1375	GS	15	10/12/1998				1.03		17300	91.5				78.8
CC1376	GS	15	10/12/1998				0.609		16900	4.11				37.7
CC1377	GS	15	10/12/1998				0.559		4070					32.9
CC1378	GS	15	10/12/1998				0.563		25200	30.1				33.2
CC1379	GS	15	10/06/1998						106000	9530				21600
CC1380	GS	15	10/06/1998					725	547000	* 74500				26600
CC1381	GS	15	10/04/1998				172		494000	5140				* 110000
CC1383	GS	15	10/12/1998				14.7		29100	430				1420
CC1386	GS	15	10/12/1998				17.6		236000	353				* 40900
CC1387	GS	15	10/12/1998				4.03		41100	277				* 34900
CC1389	GS	15	10/12/1998						154000	4050				27600
CC1390	GS	15	10/12/1998				7.58			858				722
CC1391	GS	15	10/12/1998				4.1		18900	740				381
CC1395	GS	15	10/12/1998				14.7	46.1	91500	5760				1420
CC1397	GS	15	10/13/1998				2.16	223	25400	1230				190
CC1398	GS	15	10/12/1998				0.0974	16.8	16100					
CC2000	GS	15	10/11/1998				0.862		32800	179				62.6
CC2005	GS	15	10/04/1998				2.19		18100	13.2				192
CC2006	GS	15	10/04/1998				2.29		21900	738				203
CC2009	GS	15	10/04/1998				0.0147		7610					

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
CC404	GS	11	11/10/1998	0									5.9	
CC404	GS	11	11/10/1998	0		44.6	17.3	96.4	23400	2850	2580	0.34 J		1810
CC405	GS	11	11/10/1998	0	79.3 J	103	53	897	87900	* 49800	3360	4.3 J	157	7180
CC406	GS	11	11/10/1998	0	12.7 J	141	15.7	121	25200	3590	1020	0.6 J	10.4	2680
CC407	GS	11	11/10/1998	0	25.3 J	* 3610	1.9	72.3	46300	1510	1800	0.79 J	3.7	591
CC408	GS	11	11/10/1998	0	242 J	84.7	21.8	788	77400	4750	2930	6 J	153	4340
CC426	GS	11	10/25/1998	0	1.7 J	5.8	1.8	32.1	18800	306	882	0.19 J	0.59 J	251
CC427	GS	11	10/25/1998	0	2.2 J	6.8	0.35 UJ	40.4	19300	104	503	0.12 J	0.17 U	145
CC428	GS	11	10/25/1998	0	1.7 J	6.9	3.4	32.5	16000	311	799	0.11 J	0.45 J	245
CC429	GS	11	10/25/1998	0	51.6 J	97	146	521	46000	* 63700	3020	2.2	88.9	25800
CC430	GS	11	10/25/1998	0	10.6 J	25.8	9.4	182	20100	4770	1270	0.81	10.3	2870
CC446	GS	11	11/10/1998	0	36.1 J	24.8	58.6	323	23700	* 20200	3450	5.2 J	50.3	9300
CC447	GS	11	11/10/1998	0				295	37400	* 24900	8460			
CC447	GS	11	11/10/1998	0	55.3 J	45.6	40.6					4.8 J	33	4900
Subsurface Soil (mg/kg)														
CC403	MW	11	10/27/1998	10	3.6	22.8 J	6.2 J	12 J	11900 J	514	946 J	0.06 UJ	1.2 UJ	684
CC403	MW	11	10/27/1998	20	1.3	20.4 J	0.33 UJ	18.3 J	14000 J	27.8	560 J	0.05 UJ	0.54 UJ	38
CC409	MW	11	10/27/1998	15	1 U	27.1 J	0.31 UJ	21.3 J	14600 J	98.2	503 J	0.06 UJ	0.6 UJ	104
CC414	MW	11	10/28/1998	15	11.7 UJ	11.4	0.48 J	20.7	11700	75	513	0.05 U	0.7 U	121
CC414	MW	11	10/28/1998	20	11.3 UJ	11	0.73 J	31	14600	73.9	649	0.05 U	0.68 U	172
CC415	MW	11	10/27/1998	5	14.4	13 J	8.3 J	87.7 J	17600 J	3420	1750 J	4.2	7.5 J	1160
CC415	MW	11	10/27/1998	10	239	57.4 J	186 J	303 J	45300 J	* 44600	2840 J	13	126 J	* 30000
CC415	MW	11	10/27/1998	15	6.6	6.8 J	1.2 J	15.1 J	15700 J	760	948 J	0.7	2.4 UJ	325
CC417	MW	11	10/28/1998	10	3.8	6.5 J	4.2 J	10.5 J	11000 J	663	846 J	0.11 J	1.7 UJ	824
CC418	MW	11	10/28/1998	10	11.2 UJ	5.4	3.2 J	14.8	9570	1560	633	0.11	0.67 U	513
CC419	MW	11	10/28/1998	5	764	87.2 J	441 J	370 J	50700 J	* 59300	3350 J	13.7	123 J	* 55400
CC419	MW	11	10/28/1998	25	1.3 U	2 J	0.38 UJ	3.9 J	12500 J	23.3	1140 J	0.06 UJ	0.48 UJ	25.3
CC422	MW	11	10/29/1998	10	19.6	6.3 J	1.9 J	21.5 J	7690 J	1320	781 J	0.12 J	1.1 UJ	393
CC422	MW	11	10/29/1998	15	2.8	6.4 J	1.9 J	13.6 J	9550 J	307	657 J	0.06 UJ	1.3 UJ	479
CC431	MW	11	10/24/1998	5	10.1 UJ	1.4	0.4 UJ	14.1	13400	11.8	363	0.05 U	0.61 U	44.4
CC431	MW	11	10/24/1998	45	12.4 UJ	2	0.5 UJ	21.9	21200	17.6	514	0.06 U	0.74 U	40
CC431	MW	11	10/24/1998	80	10.9 UJ	2.2	0.44 UJ	11.5	9400	13.8	619	0.05 U	0.65 U	16.8
CC432	MW	11	10/26/1998	15	9.9 UJ	0.91	1.4 J	12.2	9620	113	505	0.05 U	0.6 U	325
CC432	MW	11	10/26/1998	20	10.4 UJ	2	0.41 UJ	17.3	16600	17.2	607	0.05 U	0.62 U	31.7
CC433	MW	11	11/06/1998	5	10.1 UJ	4.3 J	3.8	16.1 J	10800	586	502 J	0.07 J	0.61 U	558
CC433	MW	11	11/06/1998	10				31.8 J			10100 J	0.05 UJ		

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Subsurface Soil (mg/kg)														
CC433	MW	11	11/06/1998	10	10.3 UJ	5 J	1.9		10200	159			0.62 U	227
CC434	MW	11	11/05/1998	5	10.5 UJ	4.9 J	1.6			103	461 J	0.05 UJ	0.63 U	267
CC434	MW	11	11/05/1998	10	11.3 UJ	3.2 J	0.54 J	15.7 J	9110	37.8	481 J	0.05 UJ	0.68 U	64.3
CC434	MW	11	11/05/1998	5				9.2 J	9770					
CC437	MW	11	10/24/1998	5	10.4 UJ	1.8	0.41 UJ	16.5	13500	12.4	234	0.05 U	0.62 U	28.7
CC437	MW	11	10/24/1998	55	11.6 UJ	1.6	0.46 UJ	15.9	22400	14.3	528	0.05 U	0.69 U	40.1
CC437	MW	11	10/25/1998	115	11.2 UJ	22.5	0.45 UJ	12.9	14000	16.8	773	0.04 U	0.67 U	24.5
CC440	MW	11	10/26/1998	10	11.4 UJ	3.1	0.45 UJ	15.2	9560	31.7	462	0.06 U	0.68 U	29.5
CC441	MW	11	11/06/1998	20	11.2 UJ	6.8 J	0.45 U	20.1 J	14100	44.3	500 J	0.06 UJ	0.67 U	43.6
CC449	MW	11	11/06/1998	6	11.3 UJ	8.1 J	2.1	9.1 J	10600	139	281 J	0.06 UJ	0.68 U	293
CC449	MW	11	11/06/1998	20	10.5 UJ	4.3 J	0.42 U	13.8 J	12000	47.1	630 J	0.05 UJ	0.63 U	68.3
CC451	MW	11	10/29/1998	25	1.2 U		0.34 UJ							
CC451	MW	11	10/29/1998	10	1.4	5.8 J	0.35 UJ	16.2 J	11700 J	111	496 J	0.06 UJ	0.62 UJ	87.6
CC451	MW	11	10/29/1998	25		4.9 J		16 J	13200 J	32.5	378 J	0.05 UJ	0.37 UJ	28.2
Sediment (mg/kg)														
CC1382	GS	15	10/12/1998				30.9		44500	* 7800				3010
CC1384	GS	15	10/12/1998				45.3		77700	2190				9360
CC1392	GS	15	10/12/1998				24.5		36500	4530				2390
CC1393	GS	15	10/12/1998				23.2	102	37900	3830				2250
CC701	TP	2	01/15/1998	2.5	85.7 J	19.3	133	185	40200	* 23900	2910	4.8	43.1	* 22900
CC702	TP	2	01/15/1998	0	4.9 UJ	4.5	8.2	19.6	8090	858	330	0.68	1.6 J	1480
CC703	TP	2	01/15/1998	1.5	51.8 J	29.1	8.9	146	30100	* 7290	1870	5	23.2	2110
Groundwater - Total Metals (ug/l)														
CC403	MW	11	12/03/1998	19	1.8 J	3.8	0.69 J	0.22 U	6.9 U	1.2 J	2.3 U	0.2 U	4.5 U	76.1
CC403	MW	23	12/05/1999	19	2 U	3.9	0.6 J	5 U	25 U	1.4 J	5 U	0.2 U	5 U	58.6
CC409	MW	11	12/03/1998	20	5.5	2.2	3.2 J	1.1 J	148 J	6.3	3.2 U	0.2 U	4.5 U	442
CC409	MW	23	12/05/1999	20	4.7 J	2.9	2.1	5 U	25 U	6.1	5 U	0.2 U	5 U	242
CC409	MW	23	12/05/1999	20	4.9 J	2.4	2.2	5 U	25 U	6.4	5 U	0.2 U	5 U	286
CC414	MW	11	12/04/1998	14	2 J	0.2 U	19.3 J	0.34 U	6.9 U	0.46 J	1.5 U	0.2 U	4.5 U	2870
CC414	MW	23	12/05/1999	14	2.2 J	1 U	11.7	5 U	25 U	0.64 J	5 U	0.2 U	5 U	1760
CC415	MW	11	12/04/1998	19.5	4.8 J	0.2 U	48.1 J	2.5 J	6.9 U	276	4.7 U	0.2 U	4.5 U	* 7950
CC415	MW	23	12/05/1999	19.5	5.2	1 U	14.2	5 U	25 U	63	5 U	0.2 U	5 U	2000
CC417	MW	11	12/04/1998	17.5	7	0.2 U	29.7	0.31 U	6.9 U			0.2 U	4.5 U	* 4400
CC417	MW	11	12/04/1998	17.5						23.7	2.4 J			

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Groundwater - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC417	MW	11	12/04/1998	11	6.8	0.2 U	29.6	0.29 U	6.9 U	23.2	1.5 U	0.2 U	4.5 U	* 4350
CC417	MW	23	12/04/1999	11	7.5	1 U	22.9	5 U	25 U	19.6	5 U	0.2 U	5 U	* 3540
CC418	MW	11	12/04/1998	40	10.5	0.2 U	28.9 J	0.66 J	6.9 U	28.6	1.5 U	0.2 U	4.5 U	* 4380
CC418	MW	11	12/04/1998	20	8.6	0.2 U	28.7 J	0.72 J	6.9 U	28.6	1.5 U	0.2 U	4.5 U	* 4280
CC418	MW	23	12/04/1999	20	8.7	1 U	19.5	5 U	25 U	20.5	5 U	0.2 U	5 U	* 3100
CC419	MW	11	12/04/1998	17	0.11 U	0.2 U	0.14 J	0.46 J	360 J	2	46.6	0.2 U	4.5 U	36.6
CC419	MW	11	12/04/1998	11	0.19 U	0.2 U	0.48 J	0.32 U	6.9 U	1.3 J	2.9 U	0.2 U	4.5 U	76.2
CC419	MW	23	12/04/1999	11	2 U	1 U	0.5 U	5 U	26.8 J	1.6 J	5 U	0.2 U	5 U	15.7
CC422	MW	11	12/05/1998	15	7.1	1 U	* 209	21.3	50 U		5 U	0.2 U	5 U	* 33800
CC422	MW	11	12/05/1998	15						698				
CC422	MW	11	12/05/1998	9	7	1 U	* 207	21.1	50 U	694	6.5 J	0.2 U	5 U	* 33600
CC422	MW	23	12/04/1999	9	6.8	1 U	110	12.1	25 U	366	5 U	0.2 U	5 U	* 18500
CC422	MW	23	12/04/1999	9	6.8	1 U	116	11.6	25 U	347	5 U	0.2 U	5 U	* 19200
CC423	MW	11	12/05/1998	9.5	2.1 J	1 U	8.2	5 U	50.1 J	25.3	5 U	0.2 U	5 U	1110
CC423	MW	23	12/04/1999	9.5	2.2 J	1 U	7.6	5 U	25 U	21	5 U	0.2 U	5 U	1060
CC431	MW	11	12/03/1998	74	0.099 U	0.2 U	0.079 U	1.3 J	383 J	2.4	38.8	0.2 U	4.5 U	2.8 J
CC431	MW	11	12/03/1998	72	0.049 U	0.2 U	0.079 U	1.7 J	6.9 U	1.8 J	2.9 U	0.2 U	4.5 U	5
CC431	MW	23	12/02/1999	72	2 U	1 U	0.5 U	5 U	473	0.84 J	17.8	0.2 U	5 U	5 U
CC432	MW	11	12/08/1998	32	0.52 U	1.3 J	0.35 J	8.3	5110	13.6	3300	0.2 U	4.5 U	68.6
CC432	MW	23	12/03/1999	32	2 U	1.5 J	0.57 J	6.4	5000	12	788	0.2 U	5 U	33.5
CC433	MW	11	12/05/1998	46	1 U	1 U	1 U	5 U	50 U	1 U	5 U	0.2 U	5 U	5.3
CC433	MW	11	12/05/1998	18	1 U	1 U	1 U	5 U	50 U	1 U	5 U	0.2 U	5 U	11
CC433	MW	11	12/05/1998	12	1 U	1 U	1 U	5 U	50 U	1 U	5 U	0.2 U	5 U	16.1
CC433	MW	23	12/04/1999	12	2 U	1 U	0.5 U	5 U	25 U	0.5 U	5 U	0.2 U	5 U	6.4
CC434	MW	11	12/05/1998	16.5	1 U	1 U	1 U	5 U	50 U	1 U	5 U	0.2 U	5 U	5 U
CC434	MW	23	12/04/1999	16.5	2 U	1 U	0.5 U	5 U	25 U	0.5 U	5 U	0.2 U	5 U	5 U
CC437	MW	11	12/03/1998	127	0.3 U	0.26 J	0.1 J	2.7 J	158 J	1.3 J	26.3	0.2 U	4.5 U	3.5 J
CC437	MW	23	12/01/1999	127	2 U	1 U	0.5 U	5 U	2040	2	81.3	0.2 U	5 U	6.3
CC437	MW	23	12/01/1999	127	2 U	1 U	0.5 U	5 U	1990	2.1	81.2	0.2 U	5 U	7.3
CC440	MW	11	12/05/1998	18	1 U	1 UJ	7.3	5 U	1910	19.1	146	0.2 U	5 U	1080
CC440	MW	23	12/03/1999	18	2 U	1 U	9.7	5 U	56.6 J	0.8 J	5 U	0.2 U	5 U	1650
CC441	MW	11	12/05/1998	15	1.4 J	1 U	9.4	5 U	80.2 J	9.9	8.5 J	0.2 U	5 U	1240
CC441	MW	23	12/03/1999	15	2 U	1 U	6.3	5 U	33.8 J	2.8	5 U	0.2 U	5 U	822
CC449	MW	11	12/07/1998	36	0.37 U	0.41 U	1.3	0.087 U	6.9 U	0.31 U	1.5 U	0.2 UJ	4.5 U	227
CC449	MW	11	12/07/1998	19	0.39 U	0.2 U	1.1	0.087 U	6.9 U	0.3 U	1.5 U	0.2 UJ	4.5 U	212
CC449	MW	11	12/07/1998	13	0.36 U	0.21 U	1.1	0.087 U	6.9 U	0.18 U	1.5 U	0.2 UJ	4.5 U	194
CC449	MW	23	12/03/1999	13	2 U	1 U	0.76 J	5 U	25 U	0.5 U	5 U	0.2 U	5 U	123

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Groundwater - Total Metals (ug/l)														
CC451	MW	11	12/07/1998	37	0.16 U	0.33 U	4.8	0.91 J	31.5 J	13.7	9.6 J	0.2 UJ	4.5 U	498
CC451	MW	11	12/07/1998	15.5	0.15 U	0.39 U	4.5	0.81 J	17 J	11.4	11.1	0.2 UJ	4.5 U	495
CC451	MW	11	12/07/1998	9.5	0.14 U	0.32 U	4.4	0.84 J	11.4 J	10.7	5 J	0.2 UJ	4.5 U	495
CC451	MW	23	12/03/1999	9.5	2 U	1 U	6.7	5 U	33.8 J	8.7	5 U	0.2 U	5 U	750
Groundwater - Dissolved Metals (ug/l)														
CC403	MW	11	12/03/1998	19	1.6 J	4	0.44 J	0.087 U	38.7 U	0.77 J	2.3 U	0.2 U	4.5 U	67.5 J
CC403	MW	23	12/05/1999	19	2 U	4.1	0.61 J	5 U	25 U	0.5 U	5 U	0.2 U	5 U	66.9
CC409	MW	11	12/03/1998	20	4.8 J	2.4	2.9 J	0.67 J	6.9 U	5.7	1.8 U	0.2 U	4.5 U	384 J
CC409	MW	23	12/05/1999	20	4.6 J	3	2.1	5 U	25 U	5.1	5 U	0.2 U	5 U	262
CC409	MW	23	12/05/1999	20	4.9 J	2.3	2.2	5 U	25 U	5.3	5 U	0.2 U	5 U	271
CC414	MW	11	12/04/1998	14	3.8 J	0.32 U	18.9 J	1.2 J	6.9 U	0.33 J	2.7 U	0.2 U	4.5 U	2890 J
CC414	MW	23	12/05/1999	14	2.2 J	1 U	11.4	5 U	25 U	0.5 U	5 U	0.2 U	5 U	2070
CC415	MW	11	12/04/1998	19.5	4.6 J	0.3 U	* 47.1 J	1.7 J	10.3 U	* 234 J	5.4 U	0.2 U	4.5 U	* 6720 J
CC415	MW	23	12/05/1999	19.5	5.5	1 U	14.3	5 U	25 U	58.3	5 U	0.2 U	5 U	2190
CC417	MW	11	12/04/1998	17.5		0.6 J		0.48 UJ	6.9 U	22.4		0.2 U	4.5 U	
CC417	MW	11	12/04/1998	17.5	6.7		29.3				2.5 J			* 4330
CC417	MW	11	12/04/1998	11	6.6	0.23 J	29	0.52 UJ	6.9 U	22.1	2.5 J	0.2 U	4.5 U	* 4330
CC417	MW	23	12/04/1999	11	7.6	1 U	22.8	5 U	25 U	17.8	5 U	0.2 U	5 U	3320
CC418	MW	11	12/04/1998	40	8.2	0.23 U	28.2 J	0.3 J	56.2 U	26.6	1.5 U	0.2 U	4.5 U	4200 J
CC418	MW	11	12/04/1998	20	8.3	0.28 U	29.1 J	0.087 U	6.9 U	27.6	1.5 U	0.2 U	4.5 U	* 4360 J
CC418	MW	23	12/04/1999	20	8.7	1 U	19.5	5 U	25 U	20.2	5 U	0.2 U	5 U	3530
CC419	MW	11	12/04/1998	17	0.049 U	0.2 U	0.079 U	0.087 U	60.2 U	0.72 J	3 U	0.2 U	4.5 U	25.8 J
CC419	MW	11	12/04/1998	11	0.049 U	0.22 U	0.079 U	0.087 U	28.9 U	0.56 J	3.8 U	0.2 U	4.5 U	41.8 J
CC419	MW	23	12/04/1999	11	2 U	1 U	0.5 U	5 U	25 U	0.5 U	5 U	0.2 U	5 U	11
CC422	MW	11	12/05/1998	15	6.7	1 U	* 212	22.8	50 U	* 684	5 U	0.2 U	5 U	
CC422	MW	11	12/05/1998	15										* 33400
CC422	MW	11	12/05/1998	9	6.8	1 U	* 211	20.1	50 U	* 692	5 U	0.2 U	5 U	* 33400
CC422	MW	23	12/04/1999	9	6.6	1 U	* 109	11.6	25 U	* 343	5 U	0.2 U	5 U	* 18300
CC422	MW	23	12/04/1999	9	6.7	1 U	* 110	12.1	25 U	* 367	5 U	0.2 U	5 U	* 18500
CC423	MW	11	12/05/1998	9.5	2.1 J	1 U	7.9	5 U	50 U	23.5	5 U	0.2 U	5 U	1090
CC423	MW	23	12/04/1999	9.5	2 J	1 U	7.5	5 U	25 U	19.5	5 U	0.2 U	5 U	1020
CC431	MW	11	12/03/1998	74	0.049 U	0.23 U	0.079 U	0.087 U	6.9 U	0.04 U	4 U	0.2 U	4.5 U	2 J
CC431	MW	11	12/03/1998	72	0.049 U	0.24 U	0.079 U	0.087 U	51.6 U	0.04 U	10.2 U	0.2 U	4.5 U	1.4 J
CC431	MW	23	12/02/1999	72	2 U	1 U	0.5 U	5 U	177	0.5 U	6.3 J	0.2 U	5 U	5 U
CC432	MW	11	12/08/1998	32	0.37 U	0.38 J	0.079 U	1.1 UJ	39.7 U	0.1 U	98	0.2 U	4.5 U	5.8
CC432	MW	23	12/03/1999	32	2 U	1 U	0.98 J	5 U	171	1.7 J	97.6	0.2 U	5 U	35.7

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Groundwater - Dissolved Metals (ug/l)														
CC433	MW	11	12/05/1998	46	1 U	1 U	1 U	5 U	50 U	1 U	5 U	0.2 U	5 U	5 U
CC433	MW	11	12/05/1998	18	1 U	1 U	1 U	5 U	50 U	1 U	5 U	0.2 U	5 U	5 U
CC433	MW	11	12/05/1998	12	1 U	1 U	1 U	5 U	50 U	1 U	5 U	0.2 U	5 U	5.4
CC433	MW	23	12/04/1999	12	2 U	1 U	0.5 U	5 U	25 U	0.5 U	5 U	0.2 U	5 U	7.9
CC434	MW	11	12/05/1998	16.5	1 U	1 U	1 U	5 U	50 U	1 U	5 U	0.2 U	5 U	5 U
CC434	MW	23	12/04/1999	16.5	2 U	1 U	0.5 U	5 U	25 U	0.5 U	5 U	0.2 U	5 U	6
CC437	MW	11	12/03/1998	127	0.049 U	0.35 U	0.079 U	0.087 U	19.6 U	0.04 U	5.1 U	0.2 U	4.5 U	1.6 J
CC437	MW	23	12/01/1999	127	2 U	1 U	0.5 U	5 U	160	0.5 U	7.6 J	0.2 U	5 U	5 U
CC437	MW	23	12/01/1999	127	2 U	1 U	0.5 U	5 U	129	0.5 U	5 U	0.2 U	5 U	5 U
CC440	MW	11	12/05/1998	18	1 U	1 U	6.2	5 U	67.4 J	1 U	81.1	0.2 U	5 U	925
CC440	MW	23	12/03/1999	18	2 U	1 U	9.3	5 U	25 U	0.5 U	5 U	0.2 U	5 U	1520
CC441	MW	11	12/05/1998	15	1.4 J	1 U	9.2	5 U	50 U	8.2	7.6 J	0.2 U	5 U	1230
CC441	MW	23	12/03/1999	15	2 U	1 U	6.5	5 U	25 U	1.9 J	5 U	0.2 U	5 U	842
CC449	MW	11	12/07/1998	36	0.41 U	0.2 U	1.4	0.087 U	6.9 U	0.04 U	2.6 J	0.2 UJ	4.5 U	215
CC449	MW	11	12/07/1998	19	0.44 U	0.2 U	1.2	0.087 U	6.9 U	0.04 U	1.5 U	0.2 UJ	4.5 U	227
CC449	MW	11	12/07/1998	13	0.86 U	0.24 U	1.1	0.087 U	6.9 U	0.04 U	1.5 U	0.2 UJ	4.5 U	205
CC449	MW	23	12/03/1999	13	2 U	1 U	0.78 J	5 U	25 U	0.5 U	5 U	0.2 U	5 U	118
CC451	MW	11	12/07/1998	37	0.16 U	0.2 U	4.7	0.89 J	6.9 U	9.2	11	0.2 UJ	4.5 U	523
CC451	MW	11	12/07/1998	15.5	0.16 U	0.2 U	4.6	0.91 J	14.1 J	10.6	14.2	0.2 UJ	4.5 U	529
CC451	MW	11	12/07/1998	9.5	0.14 U	0.2 U	4.9	1 J	6.9 U	10.2	8.7 J	0.2 UJ	4.5 U	521
CC451	MW	23	12/03/1999	9.5	2 U	1 U	6.5	5 U	25 U	7.5	5 U	0.2 U	5 U	731
Surface Water - Total Metals (ug/l)														
CC15	RV	4	05/17/1991				2.7			21				402
CC15	RV	5	10/05/1991				9.5			26				1280
CC15	RV	7	10/29/1996				6.8			32				1230
CC15	RV	7	11/27/1996				8			34				1630
CC15	RV	7	12/13/1996				14			37				2520
CC15	RV	7	01/30/1997				7.7			38				1380
CC15	RV	7	02/19/1997				10			42				1910
CC15	RV	7	03/26/1997				13			45				2230
CC15	RV	7	04/16/1997				12			34				2120
CC15	RV	7	05/15/1997				2.9			474				467
CC15	RV	7	06/24/1997				2			28				366
CC15	RV	7	07/23/1997				3			30				590
CC15	RV	7	08/14/1997				14			1440				1240
CC15	RV	7	09/04/1997				6.4			60				1060

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X
	Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC15	RV	7	10/16/1997				8			75				1210
CC15	RV	7	11/26/1997				7.7			277				1110
CC15	RV	7	12/19/1997				8.4			95				1130
CC15	RV	7	01/22/1998				14			80				1790
CC15	RV	7	02/26/1998				9			53				1360
CC15	RV	7	03/20/1998				8.8			62				1400
CC15	RV	7	04/23/1998				8.4			* 1700				1020
CC276	RV	2	11/10/1997		2.6	0.42	0.35 J	0.59 J	6.8 J	2.8	10	0.1 U	0.22 U	48.1 J
CC276	RV	4	05/18/1991				1.1			85				207
CC276	RV	5	10/05/1991				1			13				164
CC276	RV	7	10/27/1993				0.8			7				104
CC276	RV	7	11/30/1993				0.7			10				99.2
CC276	RV	7	12/17/1993				0.8			8				109
CC276	RV	7	01/20/1994				0.8			7				120
CC276	RV	7	02/18/1994				0.8			7				123
CC276	RV	7	03/08/1994				0.8			6				110
CC276	RV	7	03/24/1994				0.9			11				136
CC276	RV	7	04/07/1994				0.7			8				76
CC276	RV	7	04/19/1994				0.6			34				65
CC276	RV	7	05/04/1994				0.5 J			6				53
CC276	RV	7	05/19/1994				0.25			2.5 U				43
CC276	RV	7	06/07/1994				0.5 J			5 J				63
CC276	RV	7	06/23/1994				0.6			6				75
CC276	RV	7	07/25/1994				0.8			9				79
CC276	RV	7	08/16/1994				0.9			11				106
CC276	RV	7	09/13/1994				0.7			11				97
CC276	RV	7	10/06/1994				0.8			6				111
CC276	RV	7	11/16/1994				0.7			7				100
CC276	RV	7	12/13/1994				0.7			6				111
CC276	RV	7	01/10/1995				1			12				157
CC276	RV	7	02/09/1995				0.8			8				118
CC276	RV	7	03/08/1995				0.5 J			2.5 U				84
CC276	RV	7	03/22/1995				0.8			8				115
CC276	RV	7	04/12/1995				0.8			12				91
CC276	RV	7	04/25/1995				0.6			8				79
CC276	RV	7	05/10/1995				0.9			10				68
CC276	RV	7	05/23/1995				1			10				58

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC276	RV	7	06/13/1995				0.7			**16**				**51**
CC276	RV	7	06/27/1995				0.25 U			6				**45**
CC276	RV	7	07/11/1995				0.5 J			10				**67**
CC276	RV	7	07/25/1995				0.9			**30**				**98**
CC276	RV	7	08/14/1995				0.6			7				**83**
CC276	RV	7	09/13/1995				0.6			7				**99**
CC276	RV	3	05/15/1998		0.71	1	0.26	3 U	97.2 U	6.4	12.7	0.2 U	0.3 U	**41.5**
CC276	RV	11	11/12/1998		**6.8**	1 U	1 U	5 U	50 U	4.9	5 U	0.2 U	5 U	**48.2**
CC276	RV	23	12/05/1999		2.4 J	1 U	0.5 U	5 U	25 U	3.2	5 U	0.2 U	5 U	**31.2**
CC277	RV	2	11/10/1997		2.8	0.62	0.79	0.74 J	228	4.8	33.3	0.1 U	0.22 U	**117 J**
CC277	RV	4	05/18/1991				1.9			**177**				**115**
CC277	RV	5	10/05/1991				1.4			11				**205**
CC277	RV	3	05/15/1998		0.66	1.8	0.35	3 U	79.7 U	3.4	14.2	0.2 U	0.3 U	**47.2**
CC277	RV	11	11/12/1998		6	0.92 J	1.2	0.087 U	**470**	6.2	**59.8**	0.2 U	4.5 U	**166**
CC277	RV	11	12/04/1998		4.7 J	0.79 J	**3.4**	0.6 U	**427**	**16.6**	**53.8**	0.2 U	4.5 U	**568**
CC277	RV	23	12/05/1999		2.6 J	1 U	0.73 J	5 U	196	3.6	27.4	0.2 U	5 U	**110**
CC278	RV	2	11/10/1997		3.4	0.32	**2.2**	0.68 J	158	7.4	27.6	0.1 U	0.22 U	**352 J**
CC278	RV	4	05/17/1991				1.3			14				**167**
CC278	RV	5	10/05/1991				**2.9**			**16**				**409**
CC278	RV	7	10/27/1993				**3**			14				**491**
CC278	RV	7	11/30/1993				**5.6**			14				**583**
CC278	RV	7	12/17/1993				**3**			14				**518**
CC278	RV	7	01/20/1994				**3.4**			**17**				**561**
CC278	RV	7	02/18/1994				**2.8**			14				**518**
CC278	RV	7	03/08/1994				**3.4**			**16**				**550**
CC278	RV	7	03/24/1994				**3**			12				**392**
CC278	RV	7	04/07/1994				**2.1**			9				**331**
CC278	RV	7	04/19/1994				**2.1**			**50**				**221**
CC278	RV	7	05/04/1994				1.3			10				**154**
CC278	RV	7	05/19/1994				0.8			6				**96**
CC278	RV	7	06/07/1994				1.3			6				**151**
CC278	RV	7	06/23/1994				1.4			12				**203**
CC278	RV	7	07/25/1994				**2.2**			10				**295**
CC278	RV	7	08/16/1994				**3.1**			**18**				**480**
CC278	RV	7	09/13/1994				**2.4**			12				**374**
CC278	RV	7	10/06/1994				**2.7**			13				**406**
CC278	RV	7	11/16/1994				**2.9**			12				**424**

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC278	RV	7	12/13/1994				2.8			11				496
CC278	RV	7	01/10/1995				3.5			22				591
CC278	RV	7	02/09/1995				3			17				586
CC278	RV	7	03/08/1995				1.7			6				272
CC278	RV	7	03/22/1995				2.4			12				419
CC278	RV	7	04/12/1995				2.1			11				322
CC278	RV	7	04/25/1995				1.7			12				289
CC278	RV	7	05/10/1995				0.8			19				133
CC278	RV	7	05/23/1995				1.2			10				101
CC278	RV	7	06/13/1995				1			10				95
CC278	RV	7	06/27/1995				1			10				112
CC278	RV	7	07/11/1995				1.5			12				223
CC278	RV	7	07/25/1995				2.3			20				328
CC278	RV	7	08/14/1995				2.2			15				309
CC278	RV	7	09/13/1995				2.7			32				409
CC278	RV	3	05/14/1998		0.6	2 U	0.3	2 U	80	6.6	13	0.2 U	0.2 U	78
CC279	RV	2	11/10/1997		5.3	2.7	0.069 U	11.8	122	2	23.6	0.1 U	0.22 U	487
CC279	RV	4	05/17/1991				1.9			10				229
CC279	RV	5	10/05/1991				4.9			26				671
CC279	RV	7	01/22/1998				3.9			20				568
CC279	RV	7	02/26/1998				4			24				629
CC279	RV	7	03/20/1998				4.4			18				702
CC279	RV	7	04/23/1998				3.1			96				453
CC279	RV	7	05/07/1998				1			27				142
CC279	RV	7	05/28/1998				2.1			21				349
CC279	RV	7	06/26/1998				2.3			8				327
CC279	RV	7	07/28/1998				4			25				480
CC279	RV	7	08/26/1998				4.1			25				533
CC279	RV	7	09/24/1998				4			44				574
CC279	RV	7	10/01/1998				4.1			38				531
CC279	RV	7	10/08/1998				4.4			25				612
CC279	RV	7	10/26/1998				4.7			26				648
CC279	RV	7	11/25/1998				8.8			40				1190
CC279	RV	7	01/15/1999				8.8			24				914
CC279	RV	7	02/23/1999				4.6			21				655
CC279	RV	7	03/08/1999				4.5			18				744
CC279	RV	3	05/14/1998		0.8	2 U	0.9	2 U	90	12	14	0.2 U	0.2 U	141

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC279	RV	11	11/12/1998		7.2	1 U	5.1	5 U	245	22	34	0.2 U	5 U	782
CC279	RV	11	12/05/1998		5.9	1 U	8.6	5 U	200	25.7	33.3	0.2 U	5 U	1440
CC279	RV	11	12/05/1998		5.7	1 U	8.8	5 U	213	25.9	33.4	0.2 U	5 U	1460
CC279	RV	23	12/04/1999		3.3 J	1 U	3.4	5 U	103	11.8	18.7	0.2 U	5 U	508
CC280	RV	2	11/10/1997		3.5 J	0.77 U	3.2	0.91 J	140	12.3	35	0.1 U	0.22 U	543
CC280	RV	2	01/14/1998		4.6 J	0.55 J	3.9	0.67 J	183	16.4	37.6	0.2	0.11 U	656
CC280	RV	4	05/17/1991				2.6			15				325
CC280	RV	5	10/05/1991				4.9			68				715
CC280	RV	11	11/12/1998		6.2	0.62 J	4.8	0.087 U	214	20.7	45.8	0.2 U	4.5 U	758
CC281	RV	2	11/10/1997		4.1 J		4.3		111	30.3	29.4	0.1 U	0.22 U	673
CC281	RV	2	11/10/1997			0.42 U		1.3 J						
CC281	RV	2	01/14/1998		5.2	0.45 J	5.4	0.8 J	129	31.9	32.2	0.1 U	0.11 U	860
CC281	RV	4	05/17/1991				2.4			26				306
CC281	RV	5	10/05/1991				4.2			17				852
CC281	RV	3	05/14/1998		0.9	2 U	1.4	2 U	73	16.9	15	0.2 U	0.2 U	208
CC282	RV	2	11/09/1997		4.5 J	0.47 U	7.1	1.5 J	144	58.3	69.3	0.1 U	0.22 U	1110
CC282	RV	2	01/13/1998		10.4	1.4 J	10.4	6.6		409	139	0.15 J		
CC282	RV	2	01/13/1998						625				0.71	1530
CC282	RV	7	10/18/1995				8			66				1180
CC282	RV	7	11/21/1995				4.2			18				705
CC282	RV	7	12/27/1995				6.4			27				1070
CC282	RV	7	01/17/1996				12			53				1860
CC282	RV	7	02/29/1996				5.4			30				1080
CC282	RV	7	03/28/1996				5.3			39				1100
CC282	RV	7	04/17/1996				3.4			31				602
CC282	RV	7	05/08/1996				4.4			45				810
CC282	RV	7	06/19/1996				2.3			28				403
CC282	RV	7	07/24/1996				4.8			36				760
CC282	RV	7	08/21/1996				5.9			51				979
CC282	RV	7	09/26/1996				4.4			36				796
CC282	RV	18	05/24/1999				4		1200	480	* 39000			480
CC282	RV	7	04/23/1998				8.4			* 1700				1020
CC282	RV	7	05/07/1998				1.8			98				284
CC282	RV	7	05/28/1998				3.6			50				552
CC282	RV	7	06/26/1998				4.2			40				612
CC282	RV	7	07/28/1998				6.7			48				893
CC282	RV	7	08/26/1998				6.7			41				971

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results I [illegible] creening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC282	RV	7	09/24/1998				8.6			160				1100
CC282	RV	7	10/26/1998				8.3			47				1170
CC282	RV	7	11/25/1998				15			63				2330
CC282	RV	7	01/15/1999				13			42				1720
CC282	RV	7	02/23/1999				10			31				1470
CC282	RV	7	03/08/1999				13			40				1760
CC282	RV	3	05/14/1998		1.2	2 U	2.1	2 U	98	32.5	30	0.2 U	0.2 U	312
CC282	RV	11	11/13/1998		9.3	1.7 J	11.5	.5	1040	354	144	0.2 U	4.5 U	1660
CC282	RV	11	12/07/1998		5.2	0.69 U	15.3	1 J	178	35.1	119	0.2 UJ	4.5 U	2400
CC282	RV	23	12/03/1999		3.7 J	1 U	6.7	5 U	107	22.1	62.7	0.2 U	5 U	1120
CC291	RV	7	10/27/1993				4.8			33				763
CC291	RV	7	11/30/1993				5.2			21				861
CC291	RV	7	12/17/1993				5.8			23				912
CC291	RV	7	01/20/1994				5.5			23				922
CC291	RV	7	02/18/1994				5.6			26				937
CC291	RV	7	03/08/1994				5.2			15				813
CC291	RV	7	03/24/1994				4.6			14				754
CC291	RV	7	04/07/1994				3.6			28				1260
CC291	RV	7	04/19/1994				2.7			86				346
CC291	RV	7	05/04/1994				1.8			14				228
CC291	RV	7	05/19/1994				1.4			12				182
CC291	RV	7	06/07/1994				2.1			16				293
CC291	RV	7	06/23/1994				3			15				323
CC291	RV	7	07/25/1994				3.7			19				460
CC291	RV	7	08/16/1994				4			24				584
CC291	RV	7	09/13/1994				4.2			24				611
CC291	RV	7	10/06/1994				4.8			24				674
CC291	RV	7	11/16/1994				5.2			20				851
CC291	RV	7	12/13/1994				5			16				900
CC291	RV	7	01/10/1995				7.1			37				1060
CC291	RV	7	02/09/1995				3			12				438
CC291	RV	7	03/08/1995				2.4			12				412
CC291	RV	7	03/22/1995				4.1			22				765
CC291	RV	7	04/12/1995				3.1			10				472
CC291	RV	7	04/25/1995				2.5			32				404
CC291	RV	7	05/10/1995				2.8			30				225
CC291	RV	7	05/23/1995				1.9			21				171

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC291	RV	7	06/13/1995				1.6			22				180
CC291	RV	7	06/27/1995				1.6			17				209
CC291	RV	7	07/11/1995				2.4			16				280
CC291	RV	7	07/25/1995				3.2			25				419
CC291	RV	7	08/14/1995				3.4			19				480
CC291	RV	7	09/13/1995				4			30				619
CC291	RV	3	05/14/1998		0.8	2 U	1.5	2 U	98	10.6	23	0.2 U	0.2 U	254
CC354	AD	3	05/13/1998			2 U	3.1	2 U	1830	17.4	657	0.2 U	0.2 U	392
CC354	AD	3	05/13/1998		2.1									
CC355	AD	4	05/17/1991				11			30				* 16000
CC355	AD	5	10/05/1991				7.5			40				* 13800
CC355	AD	3	05/12/1998		0.81	3.4	11	3 U	5970	25	* 5170	0.2 U	0.3 U	
CC371	AD	2	11/16/1997					0.06 U	9.8 U		1 U	0.1 U	0.22 U	90.6
CC371	AD	2	11/16/1997		0.56 U	0.82 J	0.49			2.6				
CC372	AD	2	11/16/1997		1.1 U	2	3.3	0.21 J	461	4	208	0.1 U	0.22 U	633
CC372	AD	4	05/17/1991				9.2			3 U				1730
CC372	AD	5	10/05/1991				3.5			5				639
CC372	AD	3	05/12/1998		1.3	2.4	18.1	3 U	653	5	252	0.2 U	0.3 U	2850
CC373	AD	2	11/16/1997		0.72 U	0.57 J	0.069 U	0.64 J	220	1.6	1 U	0.1 U	0.22 U	22.2 U
CC388	AD	2	11/17/1997		1.4 U	1 J	2.9	0.64 J	146	11.8	110	0.1 U	0.22 U	298
CC388	AD	4	05/18/1991				66			838				* 6320
CC388	AD	5	10/05/1991				0.6			6				91
CC388	AD	8	04/02/1996				5 U	5 U		21.7	260	0.2 U	1 U	422
CC388	AD	3	05/12/1998		1.7	1 U	26.2	7.8	310	49	1790	0.2 U	0.3 U	2210
CC411	RV	11	11/12/1998		5.9	0.35 J	0.38 J	0.087 U	6.9 U	3.4	1.5 U	0.2 U	4.5 U	36.8
CC411	RV	23	12/05/1999		2.6 J	1 U	0.5 U	5 U	25 U	1.7 J	5 U	0.2 U	5 U	30.3
CC420	RV	11	11/12/1998		6.4	0.63 J	2.2	0.087 U	286	10	45.2	0.2 U	4.5 U	332
CC420	RV	11	12/04/1998		5.1	0.62 J	5 J	0.99 J	260 J	11.7	48	0.2 U	4.5 U	776
CC420	RV	23	12/04/1999		2.9 J	1 U	1.5	5 U	167	5.7	25	0.2 U	5 U	220
CC421	RV	11	11/12/1998		6.7	0.48 J	4.6	0.087 U	195	20.3	30.2	0.2 U	4.5 U	692
CC421	RV	23	12/04/1999		3.5 J	1 U	3.3	5 U	130	11.1	20.3	0.2 U	5 U	522
CC425	RV	11	11/12/1998		7	1 U	5.5	5 U	261	23.7	53.8	0.2 U	5 U	871
CC436	RV	11	11/12/1998			0.59 J		0.087 U		28		0.2 U	4.5 U	846
CC436	RV	11	11/12/1998		6.5		5.7		166		47.3			
CC436	RV	11	11/13/1998		6.6	0.87 J	6.4	0.35 U	470	70.9	55.9	0.29	4.5 U	968
CC436	RV	23	12/04/1999		3.6 J	1 U	5.2	5 U	127	14.3	27	0.2 U	5 U	813
CC438	RV	11	11/12/1998		6.3	0.46 J	5.4	0.087 U	211	21.7	47.1	0.2 U	4.5 U	820

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC438	RV	23	12/04/1999		3.3 J	1 U	4.7	5 U	108	13.5	25.3	0.2 U	5 U	719
CC438	RV	23	12/04/1999		3.3 J	1 U	4.7	5 U	100	13.1	25.2	0.2 U	5 U	716
CC439	RV	11	11/13/1998		6.5	0.89 J	6.6	0.61 U	512	80	59	0.2 U	4.5 U	982
CC439	RV	23	12/04/1999		3.5 J	1 U	4.9	5 U	106	14.3	24.8	0.2 U	5 U	732
CC443	RV	11	11/13/1998		9.3	1.6 J	11.3	5.6	872	315	94.6	0.2 U	4.5 U	1520
CC444	RV	11	11/13/1998		9.7	1.7 J	11.4	6.5	1040	383	114	0.2	4.5 U	1510
CC484	RV	11	11/13/1998		9	1.7 J	11.7	6.2	1060	317	138	0.2 U	4.5 U	1730
CC484	RV	23	12/03/1999		4.1 J	1 U	7.3	5 U	113	24.1	64.6	0.2 U	5 U	1270
CC485	RV	11	11/13/1998		6.9	0.67 J	7.4	0.92 U	402	124	56.5	0.2 U	4.5 U	1090
CC485	RV	23	12/03/1999		4 J	1 U	5.7	* 1020	109	20.7	23.6	0.2 U	5 U	1600
CC486	RV	11	11/13/1998		7.8	1.2 J	8.3	2.3 J	479	180	66.3	0.2 U	4.5 U	1160
CC817	OF	8	04/02/1996				5 U	5 U		6.39	652	0.2 U	1 U	69.8
CC817	OF	8	03/24/1998		45 U	40 U	2 U	3 U		25 U	716	0.2 U	4 U	57.8
Surface Water - Dissolved Metals (ug/l)														
CC15	RV	4	05/17/1991				2.1			9				405
CC15	RV	5	10/05/1991				7.6			7 U				1080
CC15	RV	7	10/29/1996				6.8			16				1210
CC15	RV	7	11/27/1996				8.3			15				1680
CC15	RV	7	12/13/1996				15			20				2570
CC15	RV	7	01/30/1997				8			18				1410
CC15	RV	7	02/19/1997				11			24				1940
CC15	RV	7	03/26/1997				13			27				2260
CC15	RV	7	04/16/1997				11			19				2200
CC15	RV	7	06/24/1997				2.1			16				440
CC15	RV	7	07/23/1997				3.3			22				638
CC15	RV	7	08/14/1997				6.6			75				977
CC15	RV	7	09/04/1997				6.4			29				1110
CC15	RV	7	10/16/1997				7.6			33				1220
CC15	RV	7	11/26/1997				6.5			66				1110
CC15	RV	7	12/19/1997				8.6			32				1190
CC15	RV	7	01/22/1998				15			40				1790
CC15	RV	7	02/26/1998				8.8			29				1380
CC15	RV	7	03/20/1998				9			30				1420
CC15	RV	7	04/23/1998				4.6			* 112				678
CC276	RV	2	11/10/1997		2.5	0.23	0.39	0.5 U	10 U	1.92	7.56	0.2 U	0.03 U	39.3
CC276	RV	4	05/18/1991				0.4			3 U				57

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC276	RV	5	10/05/1991				0.9			3				136
CC276	RV	7	10/27/1993				0.8			6				103
CC276	RV	7	11/30/1993				0.7			5				100
CC276	RV	7	12/17/1993				0.7			6				106
CC276	RV	7	01/20/1994				0.8			4				103
CC276	RV	7	02/18/1994				0.8			5				120
CC276	RV	7	03/08/1994				0.8			3 J				110
CC276	RV	7	03/24/1994				1			4				144
CC276	RV	7	04/07/1994				0.6			1.5 U				79
CC276	RV	7	04/19/1994				0.6			6				64
CC276	RV	7	05/04/1994				0.5 J			4				53
CC276	RV	7	05/19/1994				0.5 J			3 J				41
CC276	RV	7	06/07/1994				0.6			3 J				63
CC276	RV	7	06/23/1994				0.6			4				73
CC276	RV	7	07/25/1994				0.8			7				78
CC276	RV	7	08/16/1994				0.7			5				100
CC276	RV	7	09/13/1994				0.7			4				94
CC276	RV	7	10/06/1994				0.8			5				107
CC276	RV	7	11/16/1994				0.5 J			3 J				100
CC276	RV	7	12/13/1994				0.7			3 J				108
CC276	RV	7	01/10/1995				1			1.5 U				155
CC276	RV	7	02/09/1995				0.7			1.5 U				123
CC276	RV	7	03/08/1995				0.6			1.5 U				82
CC276	RV	7	03/22/1995				0.9			4				103
CC276	RV	7	04/12/1995				0.8			3 J				85
CC276	RV	7	04/25/1995				0.7			3 J				71
CC276	RV	7	05/10/1995				1			7				58
CC276	RV	7	05/23/1995				0.7			6				51
CC276	RV	7	06/13/1995				0.6			5				45
CC276	RV	7	06/27/1995				0.25 U			4				40
CC276	RV	7	07/11/1995				0.5 J			4				65
CC276	RV	7	07/25/1995				0.6			4				80
CC276	RV	7	08/14/1995				0.6			3 J				110
CC276	RV	7	09/13/1995				0.7			4				102
CC276	RV	3	05/15/1998		0.65	1 U	0.25	3 U	20 U	1.9	6.2	0.2 U	0.3 U	29.3
CC276	RV	11	11/12/1998		6.6	1 U	1 U	5 U	50 U	3.2	5 U	0.2 U	5 U	47.8
CC276	RV	23	12/05/1999		2.6 J	1 U	0.5 U	5 U	25 U	1.6 J	5 U	0.2 U	5 U	33.1

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Dissolved Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC277	RV	2	11/10/1997		2.6	0.42	0.78	0.52	160	2.43	32.3	0.2 U	0.03 U	119
CC277	RV	4	05/18/1991				0.6			3 U				77
CC277	RV	5	10/05/1991				1.4			6				173
CC277	RV	3	05/15/1998		0.63	1 U	0.34	3 U	43.5	2	12.3	0.2 U	0.3 U	44.6
CC277	RV	11	11/12/1998		6	0.69 J	1.1 J	0.087 U	319	1.6 J	62.4	0.2 U	4.5 U	149
CC277	RV	11	12/04/1998		4.7 J	0.58 J	3.1	0.35 UJ	284	3.8	54.6	0.2 U	4.5 U	528
CC277	RV	23	12/05/1999		2.7 J	1 U	0.71 J	5 U	159	2.2	28	0.2 U	5 U	118
CC278	RV	2	11/10/1997		3.1	0.31	2.39	0.66	77.2	5.16	26.9	0.2 U	0.03 U	351
CC278	RV	4	05/17/1991				0.9			3 U				148
CC278	RV	5	10/05/1991				2.8			9				321
CC278	RV	7	10/27/1993				3.1			8				497
CC278	RV	7	11/30/1993				5.6			8				465
CC278	RV	7	12/17/1993				3.1			10				507
CC278	RV	7	01/20/1994				3.3			8				531
CC278	RV	7	02/18/1994				2.9			8				521
CC278	RV	7	03/08/1994				3.4			6				540
CC278	RV	7	03/24/1994				2.8			5				400
CC278	RV	7	04/07/1994				2.4			4				334
CC278	RV	7	04/19/1994				1.5			7				201
CC278	RV	7	05/04/1994				1.3			5				152
CC278	RV	7	05/19/1994				0.7			4				103
CC278	RV	7	06/07/1994				1.2			4				159
CC278	RV	7	06/23/1994				1.4			6				190
CC278	RV	7	07/25/1994				1.7			11				286
CC278	RV	7	08/16/1994				3			11				472
CC278	RV	7	09/13/1994				2.3			7				368
CC278	RV	7	10/06/1994				2.5			7				378
CC278	RV	7	11/16/1994				2.5			6				425
CC278	RV	7	12/13/1994				3			7				493
CC278	RV	7	01/10/1995				3.4			4				545
CC278	RV	7	02/09/1995				3			7				606
CC278	RV	7	03/08/1995				1.7			3 J				273
CC278	RV	7	03/22/1995				2.5			6				383
CC278	RV	7	04/12/1995				2.1			5				305
CC278	RV	7	04/25/1995				1.8			6				274
CC278	RV	7	05/10/1995				1			8				107
CC278	RV	7	05/23/1995				1.7			6				101

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Dissolved Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC278	RV	7	06/13/1995				0.9			7				90
CC278	RV	7	06/27/1995				0.6			5				107
CC278	RV	7	07/11/1995				1.6			9				228
CC278	RV	7	07/25/1995				2.2			10				317
CC278	RV	7	08/14/1995				2			8				306
CC278	RV	7	09/13/1995				2.4			7				360
CC278	RV	3	05/14/1998		0.6	2 U	0.4	2 U	41	3.1	11	0.2 U	0.2 U	78
CC279	RV	2	11/10/1997		3.4	0.33	3.1	0.75	44.6	9.53	23	0.2 U	0.03 U	477
CC279	RV	4	05/17/1991				1.4			3 U				210
CC279	RV	5	10/05/1991				4.6			9				522
CC279	RV	7	01/22/1998				4			13				561
CC279	RV	7	02/26/1998				4.1			14				628
CC279	RV	7	03/20/1998				4			12				700
CC279	RV	7	04/23/1998				2.1			11				391
CC279	RV	7	05/07/1998				1			10				152
CC279	RV	7	05/28/1998				2.2			12				359
CC279	RV	7	06/26/1998				2.3			8				334
CC279	RV	7	07/28/1998				3.8			20				480
CC279	RV	7	08/26/1998				4.1			17				528
CC279	RV	7	09/24/1998				3.7			16				516
CC279	RV	7	10/01/1998				3.9			16				505
CC279	RV	7	10/08/1998				4.5			16				600
CC279	RV	7	10/26/1998				4.3			13				630
CC279	RV	7	11/25/1998				8.1			17				1220
CC279	RV	7	01/15/1999				6.2			13				923
CC279	RV	7	02/23/1999				4.4			9				641
CC279	RV	7	03/08/1999				4.8			11				763
CC279	RV	3	05/14/1998		0.9	2 U	2.3	2 U	30	6.3	10	0.2 U	0.2 U	128
CC279	RV	11	11/12/1998		7.3	1 U	4.8	5 U	50 U	5.5 J	32.5	0.2 U	5 U	757
CC279	RV	11	12/05/1998		5.7	1 U	8.7	5 U	66 J	14	31.9	0.2 U	5 U	1400
CC279	RV	11	12/05/1998		5.6	1 U	8.5	5 U	59.1 J	13.6	36.5	0.2 U	5 U	1380
CC279	RV	23	12/04/1999		3.2 J	1 U	3.2	5 U	36.1 J	5.7	18.7	0.2 U	5 U	531
CC280	RV	2	11/10/1997		3.3	0.28	3.17	0.58	55	8.39	32.4	0.2 U	0.03 U	503
CC280	RV	2	01/14/1998		4.2 J	0.31 J	3.3	0.34 J	53.8	7.5	38.4	0.1 U	0.11 U	669
CC280	RV	4	05/17/1991				1.7			3				320
CC280	RV	5	10/05/1991				4.8			9				564
CC280	RV	11	11/12/1998		6.2	0.32 J	4.3 J	0.5 U	9.5 U	4.3	45.1	0.2 U	4.5 U	709

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC281	RV	2	11/10/1997			0.28			37.7		27.4	0.2 U	0.03 U	
CC281	RV	2	11/10/1997		3.9		4.84	0.77		17.3				664
CC281	RV	2	01/14/1998		4.7 J	0.14 J	4.9	0.42 J	36.5	15.2	32.8	0.1 U	0.11 U	881
CC281	RV	4	05/17/1991				1.5			4				274
CC281	RV	5	10/05/1991				6			6				632
CC281	RV	3	05/14/1998		0.9	2 U	1.3	2 U	36	9.4	14	0.2 U	0.2 U	219
CC282	RV	2	11/09/1997		4.1	0.29	7.95	0.95	57	36.2	70.2	0.2 U	0.03 U	1140
CC282	RV	2	01/13/1998				9.6	0.78 J				0.1 U		
CC282	RV	2	01/13/1998		4.9 J	0.25 J			55.2	43.7	88.3		0.6	1400
CC282	RV	7	10/18/1995				7			15				1130
CC282	RV	7	11/21/1995				4.2			12				686
CC282	RV	7	12/27/1995				6.4			19				1110
CC282	RV	7	01/17/1996				11			25				1860
CC282	RV	7	02/29/1996				5.3			19				1100
CC282	RV	7	03/28/1996				5.3			21				1120
CC282	RV	7	04/17/1996				3.4			21				608
CC282	RV	7	05/08/1996				4.6			22				830
CC282	RV	7	06/19/1996				2.3			15				400
CC282	RV	7	07/24/1996				4.8			20				739
CC282	RV	7	08/21/1996				5.7			12				884
CC282	RV	7	09/26/1996				4.7			18				778
CC282	RV	18	05/24/1999				2.6		19	14	140			340
CC282	RV	7	04/23/1998				4.6			* 112				678
CC282	RV	7	05/07/1998				1.6			23				278
CC282	RV	7	05/28/1998				3.6			19				564
CC282	RV	7	06/26/1998				4.3			22				624
CC282	RV	7	07/28/1998				6.8			40				891
CC282	RV	7	08/26/1998				6.7			27				981
CC282	RV	7	09/24/1998				8.4			52				1090
CC282	RV	7	10/26/1998				7.9			26				1170
CC282	RV	7	11/25/1998				16			26				2380
CC282	RV	7	01/15/1999				12			22				1660
CC282	RV	7	02/23/1999				10			17				1420
CC282	RV	7	03/08/1999				11			19				1730
CC282	RV	3	05/14/1998		1.1	2 U	2.1	2 U	45	16.9	29	0.2 U	0.2 U	315
CC282	RV	11	11/13/1998		6	0.2 U	9.8 J	0.41 U	18.8 U	12.8	89.1	0.2 U	4.5 U	1390
CC282	[illegible]	11	12/07/1998		5.2	0.44 U	15.9	0.66 J	118	18.6	124	0.2 UJ	4.5 U	2480

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC282	RV	23	12/03/1999		3.9 J	1 U	7.2	5 U	33.5 J	11.3 J	62.9	0.2 U	5 U	1150
CC291	RV	7	10/27/1993				5.1			12				759
CC291	RV	7	11/30/1993				5.2			14				861
CC291	RV	7	12/17/1993				5.5			14				907
CC291	RV	7	01/20/1994				5.6			12				920
CC291	RV	7	02/18/1994				5.7			12				897
CC291	RV	7	03/08/1994				5.5			11				842
CC291	RV	7	03/24/1994				5			9				789
CC291	RV	7	04/07/1994				3.9			18				1280
CC291	RV	7	04/19/1994				2.2			9				308
CC291	RV	7	05/04/1994				1.8			8				230
CC291	RV	7	05/19/1994				1.5			11				191
CC291	RV	7	06/07/1994				2.2			8				301
CC291	RV	7	06/23/1994				2.5			11				311
CC291	RV	7	07/25/1994				3.4			10				451
CC291	RV	7	08/16/1994				3.9			15				562
CC291	RV	7	09/13/1994				4			10				571
CC291	RV	7	10/06/1994				4.4			13				660
CC291	RV	7	11/16/1994				5.2			9				856
CC291	RV	7	12/13/1994				5.2			9				915
CC291	RV	7	01/10/1995				5.2			8				1020
CC291	RV	7	02/09/1995				2.6			6				453
CC291	RV	7	03/08/1995				2.5			6				398
CC291	RV	7	03/22/1995				4.4			11				696
CC291	RV	7	04/12/1995				2.9			5				452
CC291	RV	7	04/25/1995				2.4			9				381
CC291	RV	7	05/10/1995				2.7			11				195
CC291	RV	7	05/23/1995				2.1			10				175
CC291	RV	7	06/13/1995				1.3			10				168
CC291	RV	7	06/27/1995				1.8			11				217
CC291	RV	7	07/11/1995				2.3			11				260
CC291	RV	7	07/25/1995				3			17				415
CC291	RV	7	08/14/1995				3.5			12				489
CC291	RV	7	09/13/1995				4.2			10				598
CC291	RV	3	05/14/1998		0.8	2 U	1.6	2 U	46	4.8	22	0.2 U	0.2 U	251
CC354	AD	3	05/13/1998		1.4	2 U		2 U		0.2		0.2 U	0.2 U	
CC354	AD	3	05/13/1998				1.5		40		691			363

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Dissolved Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC355	AD	4	05/17/1991				9.1			3 U				* 17300
CC355	AD	5	10/05/1991				7.5			0.1 U				* 14100
CC355	AD	3	05/12/1998		0.5 U	2.5	10.8	3 U	4810	0.5 U	* 5160	0.2 U	0.3 U	
CC371	AD	2	11/16/1997		0.5 U	0.78	0.53	0.5 U	10 U		1 U	0.2 U	0.03 U	
CC371	AD	2	11/16/1997							2.23				88.6
CC372	AD	2	11/16/1997			1.2			34.8		213			586
CC372	AD	4	05/17/1991				5.1			3 U				1720
CC372	AD	5	10/05/1991				1.4			0.1 U				501
CC372	AD	3	05/12/1998		1.3	1.4	16.6	3 U	369	0.5 U	248	0.2 U	0.3 U	2790
CC373	AD	2	11/16/1997		0.68	0.49	0.04 U	0.5 U	10 U	0.88	1 U	0.2 U	0.03 U	7.08
CC388	AD	2	11/17/1997		1.4	0.84	3.15	0.27	10 U	2.12	102	0.2 U	0.03 U	277
CC388	AD	4	05/18/1991				* 64.3			* 308				* 6550
CC388	AD	5	10/05/1991				0.3			0.1 U				12 U
CC388	AD	3	05/12/1998		1.7	2.8	26	3 U	20 U	81.9	1770	0.2 U	0.3 U	2120
CC411	RV	11	11/12/1998		6	0.45 J	0.46 J	0.11 U	101	2.2	1.5 U	0.2 U	4.5 U	39
CC411	RV	23	12/05/1999		2.5 J	1 U	0.5 U	5 U	25 U	1.4 J	5 U	0.2 U	5 U	28.4
CC420	RV	11	11/12/1998		6.4	0.45 J	1.9 J	0.15 U	36.7 U	2.4	45.7	0.2 U	4.5 U	303
CC420	RV	11	12/04/1998		4.8 J	0.72 U	4.5 J	0.1 J	109 U	6.1	47.9	0.2 U	4.5 U	673 J
CC420	RV	23	12/04/1999		2.8 J	1 U	1.4	5 U	79.3 J	2.1	24.7	0.2 U	5 U	237
CC421	RV	11	11/12/1998		6.7	0.28 J	4.3 J	0.29 U	6.9 U	5.3	29.9	0.2 U	4.5 U	655
CC421	RV	23	12/04/1999		3.5 J	1 U	3.3	5 U	30.3 J	5.8	19.5	0.2 U	5 U	510
CC425	RV	11	11/12/1998		6.6	1 U	5	5 U	440	4.1	54.4	0.2 U	5 U	843
CC436	RV	11	11/12/1998		6.5		5.5 J	0.28 U	6.9 U	5		0.2 U	4.5 U	816
CC436	RV	11	11/12/1998			0.25 J					47.9			
CC436	RV	11	11/13/1998		7	1.7 J	5.7 J	0.087 U	16.8 U	5.4	46.6	0.2 U	4.5 U	841
CC436	RV	23	12/04/1999		3.5 J	1 U	4.8	5 U	30.2 J	5.4	26.4	0.2 U	5 U	777
CC438	RV	11	11/12/1998		6.2	0.27 J	5 J	0.22 U	6.9 U	4.2	45.6	0.2 U	4.5 U	780
CC438	RV	23	12/04/1999		3.3 J	1 U	4.7	5 U	28.9 J	5.8	25.6	0.2 U	5 U	776
CC438	RV	23	12/04/1999		3.3 J	1 U	4.6	5 U	25 U	5.9	25.5	0.2 U	5 U	770
CC439	RV	11	11/13/1998		6	0.35 J	5.6 J	0.36 U	6.9 U	5.9	46.1	0.2 U	4.5 U	917
CC439	RV	23	12/04/1999		3.4 J	1 U	4.6	5 U	46.2 J	8	25	0.2 U	5 U	768
CC443	RV	11	11/13/1998		6.1	0.36 J	10.2 J	0.62 U	6.9 U	15.5	45.4	0.2 U	4.5 U	1350
CC444	RV	11	11/13/1998		6.2	0.2 U	9.7 J	0.57 U	6.9 U	15.9	42.6	0.2 U	4.5 U	1310
CC484	RV	11	11/13/1998		6	0.2 U	10.1 J	0.59 U	6.9 U	12.8	88.9	0.2 U	4.5 U	1450
CC484	RV	23	12/03/1999		4 J	1 U	7.1	5 U	34.8 J	10.2	62.1	0.2 U	5 U	1230
CC485	RV	11	11/13/1998		6.4	0.24 J	7 J	0.087 U	6.9 U	7.8	43.3	0.2 U	4.5 U	1010
CC485	RV	23	12/03/1999		4 J	1 U	5.8	5 U	31.8 J	7.8	21.5	0.2 U	5 U	893

Data Summary Table
Canyon Creek - segment CCSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC486	RV	11	11/13/1998		6.7	0.24 J	7.4 J	0.2 U	6.9 U	10.7	44.6	0.2 U	4.5 U	1080

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
CC11193	FP	16	—			33.3	4.9	91.7	19500	7960	750			590
CC11194	FP	16	—			44.3	44.8	150	38300	9540	2240			7270
CC11195	FP	16	—			53.8	24.6	168	52300	11300	3770			4790
CC11196	FP	16	—			19.5	43.8	135	26100	5460	1490			7450
CC11197	FP	16	—			52.4	5.4	182	36900	* 33300	527			1120
CC11198	FP	16	—			65.25	12.1	156.5	51800	* 42200	341.5			1810
CC1400	GS	15	10/03/1998				2.8	155	9960	1860				252
CC1400	GS	15	10/10/1998				0.841		14300	193				60.5
CC1410	GS	15	10/03/1998				4.51	107	16700	3670				421
CC1413	GS	15	10/03/1998				13.1	106	19900	1850				1260
CC1416	GS	15	10/13/1998				0.718		5750					48.4
CC1417	GS	15	10/13/1998				25.2		23500	1290				2450
CC1422	GS	15	10/03/1998				11.1		17800	3570				1060
CC1423	GS	15	10/03/1998				17.9		19500	394				1740
CC1428	GS	15	10/03/1998				11.2	243	42100	* 17400				1080
CC1439	GS	15	10/03/1998				8.39	44.7	22400	4190				802
CC1441	GS	15	10/03/1998				8.19		23600	13400				782
CC1446	GS	15	10/03/1998				7.98		14200	2680				761
CC1448	GS	15	10/03/1998				6.5		21700	114				616
CC1455	GS	15	10/03/1998				9.06		25000	4210				867
CC1458	GS	15	10/03/1998				4.57		24700	352				427
CC1465	GS	15	10/03/1998				7.03	50.6	20400	2740				667
CC1467	GS	15	10/03/1998				4.18		25700	126				389
CC1475	GS	15	10/03/1998				11.6		28000	4110				1120
CC1477	GS	15	10/03/1998				5.07	72.4	22700	219				476
CC1483	GS	15	10/03/1998				12	58.9	25900	7260				1160
CC1485	GS	15	10/03/1998				12.6		22000	1280				1220
CC2001	GS	15	10/09/1998				0.231		19100	62.3				0.691
CC470	GS	11	11/10/1998	0	13.9 J	27.8 J	21.4	190 J	33000	8270	1490 J	4.9 J	19.1	3850
CC471	GS	11	11/10/1998	0		17.9	1.2	29.7	20600	1860	988	0.3 J	1.4 J	208
CC472	GS	11	11/10/1998	0	70.3 J	41.3	148	412	46600	* 32300	2580	15.5 J	82.3	24300
CC473	GS	11	11/10/1998	0	24.1 J	36.9	41.4	165	42600	9490	3650	4.5 J	21.8	5320
CC474	GS	11	11/10/1998	0	9.8 J	23.2	36.6	108	44900	7900	4920	3 J	12.9	5330
CC475	GS	11	11/10/1998	0	16.8 J	43.5	24.9	156	33300	7650	2690	4.1 J	19.3	4060
CC476	GS	11	11/10/1998	0		2.2	17.2	30.7	8670	1200	195	0.17 J	0.99 J	1330
CC477	GS	11	11/10/1998	0	34.7 J	215	35.6	284	58000	16100	3930	3.5 J	35.4	5380
CC478	GS	11	11/10/1998	0		13.6		82.7		3710	764	1.2 J		

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
CC478	GS	11	11/10/1998	0			23.7		19300				4.9	2980
CC479	GS	11	11/10/1998	0		10.1	11.9	103	23100	4880	1120	3.3 J	12.2	1030
CUA1011	BH	10	09/02/1998	0	1 U	12.3	0.2 U	28.2	20800	93.4	665	0.1 U	0.4 U	173
CUA1012	BH	10	09/02/1998	0			0.52 J					0.1 U		
CUA1012	BH	10	09/02/1998	0	1.8 J	13.8		34.7	21400	210	802		0.87 J	381 J
CUA1013	BH	10	09/02/1998	0	0.75 J	11.2	0.49 J	26.5	19400	141	694	0.05 U	0.53 J	106
CUA1014	BH	10	09/02/1998	0	4.5 J	15.8	2.9 J	50.5	19800	673	1020	0.2 U	2.7	688
CUA1015	BH	10	09/02/1998	0	0.67 J	10.8 J	0.3 J	26.8	20000	77.6	717	0.05 U	0.46 J	120
CUA1016	BH	10	09/02/1998	0	0.98 U	11.2	0.2 U	28.4	21400	76.8	660	0.1 U	0.39 U	166
CUA1017	BH	10	09/02/1998	0	1 U	11.7	0.2 U	30.4	19700	117	690	0.1 U	0.48 J	226
Subsurface Soil (mg/kg)														
CC452	MW	11	10/29/1998	15	1.1 U	3.9 J	0.31 UJ	12.2 J	8270 J	20.5	995 J	0.05 UJ	0.57 UJ	64
CC452	MW	11	10/29/1998	35	1.4 U	2.1 J	0.4 UJ	26.7 J	27000 J	27.7	560 J	0.06 UJ	0.5 UJ	68.7
CC452	MW	11	10/29/1998	35		2.2 J								
CC453	MW	11	11/05/1998	5	29 J	10.7 J	15.8	45.9 J	11000	6440	958 J	1.1 J	11.5	797
CC456	MW	11	11/05/1998	5	10.4 UJ	21.2 J	1.4	9.6 J	10100	149	113 J	0.05 UJ	0.62 U	440
CC456	MW	11	11/05/1998	15	10.1 UJ	8.7 J	0.4 U	24 J	14900	40.6	614 J	0.06 UJ	0.61 U	58.4
CC459	MW	11	11/16/1998	10		3.7	1.6	13.6	7230	84.7	380	0.05 UJ	0.2 U	212
CC459	MW	11	11/16/1998	35		9	0.33 UJ	16.8	17800	36.3	187	0.06 UJ	0.17 U	80.4
CC460	MW	11	11/18/1998	5		3.1	3.8	6.1	9150	74.2	487	0.05 UJ	0.19 U	263
CC460	MW	11	11/18/1998	20	0.6 J	2.6	2.3	13	6160	22	331	0.05 UJ	0.16 U	225
CC462	MW	11	11/13/1998	10		3.3	2.7	13.3	7360	44.4	730	0.06 UJ	0.19 U	338
CC462	MW	11	11/13/1998	5	0.64 UJ	1.4 J	0.92 J	6.9	1980	17.8	246 J	0.05 UJ	0.21 U	141 J
CC463	MW	11	11/07/1998	10	20 J	7.7	4.3	37.5	13700	1570	564	0.31	5.3	792
CC463	MW	11	11/09/1998	40		5.8	0.37 U	17.1	12200	26.4	582	0.06 UJ	0.21 U	93.3
CC464	MW	11	11/11/1998	5	30.2 J					6790			16.2	
CC464	MW	11	11/11/1998	43		6.4	0.4 U	22	39400	7.5	366	0.06 UJ	0.22 U	199
CC464	MW	11	11/11/1998	20		6	2.2	21	14700	26.9	526	0.06 UJ	0.22 U	272
CC464	MW	11	11/11/1998	5		12.2	8.4	51.9	21400		867 J	5		960 J
CC465	MW	11	11/10/1998	10	0.84 J	10.4	0.72 J	16.9	11200	78.8	615	0.05 UJ	0.21 U	242
CC465	MW	11	11/10/1998	5	0.86 J	3.8	2.8	13.6	7480	126	451	0.15 J	0.36 J	405
CC467	MW	11	11/09/1998	6	10.7 UJ	5.4 J	2.5	13 J	9890	925	1040 J	0.05 UJ	0.64 U	181
CC468	MW	11	11/10/1998	10		3.1	0.28 U	11.6	7980	18.2	321	0.05 UJ	0.16 U	34.9
CC469	MW	11	11/09/1998	10		5.4	0.36 U	10.5	6460	86.8	38.8	0.06 UJ	0.2 U	61.9
CC469	MW	11	11/09/1998	15		7	1.7	3.5 J	9580	64.8	57.1	0.32	0.2 U	708
CC480	[illegible]	11	11/04/1998	5	14.2 UJ	4.8 J	8.7	[illegible]	8490	114	123 J	0.06 UJ	0.85 U	1290

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Subsurface Soil (mg/kg)														
CC481	MW	11	11/17/1998	5	14.1 J	5.5	3.9	27.9	7230	2450	423	0.66	6.4	593
CC481	MW	11	11/17/1998	12	0.99 J	3.9	0.71 J	11.5	6800	114	361	0.19 J	0.22 J	143
CUA1011	BH	10	09/02/1998	0.08	2.7 J	15.1	3.3	49	23500	967	805	0.25	2.2	469
CUA1011	BH	10	09/02/1998	0.5	5.2 J	11.8	12.4	54.4	19600	1310	672	0.58	2.8	2040
CUA1011	BH	10	09/02/1998	1	2.5 J	10.8	9.1	44.9	20900	925	861	0.39	1.9 J	1950 J
CUA1012	BH	10	09/02/1998	1	28.1 J	37.9	20.7 J	212	40800	6460	2640	2.7	21.8	2730
CUA1012	BH	10	09/02/1998	0.08	4.9 J	18.5	5.1	73.5	22900	1500	1180	0.73	5.6	871 J
CUA1012	BH	10	09/02/1998	0.5	15.4	36	14.6	161	34500	4210	1930	2.1	13.9	2320 J
CUA1013	BH	10	09/02/1998	0.08	5.1 J	14.6	5.4 J	54.1	21700	1060	846	0.5	2.8	586
CUA1013	BH	10	09/02/1998	0.5	15.2 J	19.8	15.1 J	101	24100	2650	1140	1.1	6.9	2240
CUA1013	BH	10	09/02/1998	1	13.7 J	17.5	14.8 J	110	21200	2830	1160	1.1	6.2	2310
CUA1013	BH	10	09/02/1998	1.5	5.2 J	9.9	5.5 J	49.1	17600	925	1180	0.3	2.5	1150
CUA1014	BH	10	09/02/1998	0.08	20 J	28.4 J	12.8	177	42300	4730	2640	2.2	17.1	2150
CUA1014	BH	10	09/02/1998	0.5	33.1 J	31.5 J	30.7					3.5		
CUA1014	BH	10	09/02/1998	0.5				263	45200	6840	2990		25.7	3660
CUA1014	BH	10	09/02/1998	1	18.1 J	24.7 J	22	210	34400	4750	1990	2.3	16.9	3160
CUA1015	BH	10	09/02/1998	0.08	2.8 J	15.2	2.1	49.8	25800	651	911	0.18	2 J	471
CUA1015	BH	10	09/02/1998	0.5	18.6	30.4	17.7	182	37000	4090	1640	1.1	14.4	2630
CUA1015	BH	10	09/02/1998	1	11.4 J	32.5	28	210	37400	5640	1640	1.5	15.9	3850
CUA1016	BH	10	09/02/1998	0.08	31.3	45.8	30.8	310	51900	7530	2860	4.5	28.4	4050
CUA1016	BH	10	09/02/1998	0.5	29.7	49.1	64.1	329	51100	8460	2730	4.7	29.9	7110
CUA1016	BH	10	09/02/1998	1	25.7			230				4.4	20.4	
CUA1016	BH	10	09/02/1998	1	16.4	40	55.3	221	37100	6690	1990	3.2	20.2	6240 J
CUA1017	BH	10	09/02/1998	0.08	0.99 U	10.4	0.2 U	26.1	20500	38.1	639	0.1 U	0.4 U	112
CUA1017	BH	10	09/02/1998	0.5	7.9 U	21.9	6.7	92.2	26400	1740	1230	0.58	6.5	1000
CUA1017	BH	10	09/02/1998	1	9.2 J	36.6	15.8	155	33400	3630	2040	1.8	14.2	2480 J
Sediment (mg/kg)														
CC694	TP	2	01/14/1998	1.5	203 J	90.7	54.4	1500	67800	* 13000	2280	* 24	99.6	8770
CC695	TP	2	01/14/1998	0	288 J	8.4	132	510	28100	* 67100	1820	1.1	105	* 22400
CC696	TP	2	01/14/1998	3.5	28.6 J	12.2	5.1	81.6	30700	5100	594	2.6	10.1	882
CC697	TP	2	01/15/1998	1.5								0.3	0.56 J	
CC697	TP	2	01/15/1998	1.5	2.3 UJ	3.6	6.8	31.4	7760	1790	538			1050
CC699	TP	2	01/15/1998	0	8.5 UJ	15.9	5.3	87.4	20200	3870	1130	0.27	7.2	972
CC700	TP	2	01/15/1998	1.5	27.8 J	25.6	8.8	118	27700	* 5410	1820	3.9	11.6	1940
CC704	TP	2	01/15/1998	2.5	1 J	7.8	7.7	19.1	13300	37.4	608	0.09 J	0.42 J	703
CC705	TP	2	01/15/1998	0	18.6 J	14.3	6.3	27.1	13000	4030	1130	0.07 J	6.5	844

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Sediment (mg/kg)														
CC706	TP	2	01/15/1998	1.5	1 J	5.5	9.6	62.8	16000	1020	1020	0.22	1.2 J	1260
Groundwater - Total Metals (ug/l)														
CC1490	MW	12	04/02/1993			5	* 520			913				* 82400
CC1490	MW	12	05/02/1993			13.5	* 450			* 3030				* 69000
CC1490	MW	12	11/06/1996			250	* 484			* 15294				* 75410
CC1491	MW	12	04/02/1993			8	156			* 2400				* 26600
CC1491	MW	12	05/26/1993			19	167			* 5640				* 25300
CC1491	MW	12	11/06/1996			35 U	96			* 2000				* 11970
CC1492	MW	12	04/02/1993			2 U	* 235			28				* 26300
CC1492	MW	12	05/26/1993			1.6	* 240			21				* 27200
CC1492	MW	12	11/06/1996			35 U	* 208			75				* 22870
CC1493	MW	12	04/02/1993			41	* 210			127				* 28300
CC1493	MW	12	05/26/1993			1 U	111			5				* 19500
CC1493	MW	12	11/06/1996			35 U	132			141				* 22780
CC1494	MW	12	04/02/1993			2 U	* 212			774				* 29500
CC1494	MW	12	05/26/1993			1.5	178			* 1680				* 24000
CC1494	MW	12	11/06/1996			35 U	52			923				* 7500
CC1496	MW	12	10/28/1996			35 U	* 330			* 2458				* 41130
CC1497	MW	12	11/11/1996			191	* 943			* 49890				* 81150
CC1498	MW	12	11/06/1996			35 U	128			* 5756				* 18490
CC1499	MW	12	11/06/1996			35 U	* 556			* 23630				* 33160
CC1501	MW	12	11/06/1996			35 U	* 1125			1423				* 47000
CC1504	MW	12	10/28/1996			75	17			* 2833				1964
CC1505	MW	12	10/28/1996			113	143			* 32857				* 27270
CC1506	MW	12	10/28/1996			96	* 847			* 16818				* 93700
CC1507	MW	12	10/28/1996			63	161			* 5489				* 41750
CC1508	MW	12	10/28/1996			35 U	* 714			* 5400				* 89260
CC1509	MW	12	11/06/1996			35 U	* 596			* 8200				* 93440
CC1510	MW	12	11/06/1996			35 U	184			* 6200				* 26940
CC1511	MW	12	11/06/1996			35 U	* 480			* 6733				* 23330
CC1512	MW	12	11/06/1996			35 U	72			* 2654				* 11820
CC1513	MW	12	11/06/1996			92	* 2551			* 54894				* 73770
CC1514	MW	12	11/06/1996			35 U	* 591			* 11588				* 105740
CC1515	MW	12	11/06/1996			35 U	132			* 9954				* 21200
CC452	MW	11	12/05/1998	13.5	1 U	1 U	43.1	5 U	50 U	65.9	12.7	0.2 U	5 U	* 5360
CC452	MW	23	12/02/1999	13.5	2 U	1 UJ	22.2	5 U	25 U	37.1	5 U	0.2 U	5 U	2530

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Groundwater - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC453	MW	11	12/07/1998	32.5	0.23 U	0.61 U	* 222		6.9 U	337	13.8	0.2 UJ	4.5 U	* 35400
CC453	MW	11	12/07/1998	32.5				30.4						
CC453	MW	11	12/07/1998	18	0.16 U	0.52 U	157 J	25	6.9 U	215 J	11.3	0.2 UJ	4.5 U	* 36300
CC453	MW	11	12/07/1998	12	0.19 U	0.58 U	* 226	24.8	7.1 J	366	13.2	0.2 UJ	4.5 U	* 35100
CC453	MW	23	12/02/1999	12	2 U	1 UJ	177	20.3	25 U	463	5 U	0.2 U	5 U	* 27700
CC453	MW	23	12/02/1999	32.5	2 U	1 UJ	175	20	25 U	285	5 U	0.2 U	5 U	* 27500
CC456	MW	11	12/09/1998	28	1 U	1 U	5	5 U	50 U	1 U	5 U	0.2 U	5 U	1190
CC456	MW	11	12/09/1998	14	2.4 J	1.1 J	4.7	5 U	50 U	5.3	5 U	0.2 U	5 U	972
CC456	MW	11	12/09/1998	8	2.4 J	1 U	4.8	5 U	50 U	5.1	5 U	0.2 U	5 U	966
CC456	MW	23	12/02/1999	8	2 U	1.2 J	5	5 U	25 U	5.9	5 U	0.2 U	5 U	1030
CC456	MW	23	12/02/1999	8	2 U	1 J	4.9	5 U	25 U	5.7	5 U	0.2 U	5 U	1000
CC459	MW	11	12/08/1998	45.7	0.74 U	0.57 J	* 240	23.4	6.9 U	9.2	29.7	0.2 U	4.5 U	* 41900
CC459	MW	11	12/08/1998	22.8	0.71 U	0.37 J	* 246	23.8	6.9 U	9.4	56.8	0.2 U	4.5 U	* 43100
CC459	MW	11	12/08/1998	16.8	0.1 U	0.62 J	* 258	25.3	6.9 U	10	2.7 J	0.2 U	4.5 U	* 45400
CC459	MW	23	12/03/1999	45.7	2.2 J	1 U	69.1	8.4	74.8 J	8.1	17.4	0.2 U	5 U	* 11300
CC459	MW	23	12/03/1999	16.8	2.1 J	1 U	68.4	7.8	25 U	3.2	10.5	0.2 U	5 U	* 11200
CC460	MW	11	12/07/1998	47.6	1.6 J	0.2 U	56.5	1.7 J	6.9 U	10.4	1.8 J	0.2 UJ	4.5 U	* 6970
CC460	MW	11	12/07/1998	13.8	1.5 U	0.3 U	50.2	1.5 J	6.9 U	11.9	1.5 U	0.2 UJ	4.5 U	* 6340
CC460	MW	11	12/07/1998	7.8	1.7 J	0.47 U	42.3	0.9 J	6.9 U	9.9	1.5 U	0.2 UJ	4.5 U	* 5640
CC460	MW	23	12/03/1999	7.8	2 U	1 U	45.1	5 U	25 U	8.5	5 U	0.2 U	5 U	* 6260
CC460	MW	23	12/03/1999	47.6	2 U	1 U	52.6	5 U	25 U	9.7	5 U	0.2 U	5 U	* 7250
CC462	MW	11	12/08/1998	13	1.2 J			0.56 U			1030	0.2 U	4.5 U	
CC462	MW	11	12/08/1998	13		0.38 J	185		29.1 J	226				* 37700
CC462	MW	11	12/08/1998	7	1.2 J	0.39 J	186	0.57 U	111	249	1040	0.2 U	4.5 U	* 38500
CC462	MW	23	12/04/1999	9	2 U	1 U	134	5 U	284	236	888	0.2 U	5 U	* 34600
CC462	MW	23	12/04/1999	32	2 U	1 U	119	5 U	895	452	790	0.2 U	5 U	* 31400
CC463	MW	11	12/07/1998	63	0.54 U	0.37 U	147	39.2	6.9 U	15.6	8.3 J	0.2 UJ	4.6 J	* 18400
CC463	MW	11	12/07/1998	13	0.53 U	0.39 U	149	41.2	6.9 U	19.4	7.3 J	0.2 UJ	4.5 U	* 16400
CC463	MW	11	12/07/1998	7	0.45 U	0.26 U	138	20.4	6.9 U	8.5	21.9	0.2 UJ	4.5 U	* 19200
CC463	MW	23	12/02/1999	9	2 U	1 U	122	28.2	25 U	7.6	5 U	0.2 U	5 U	* 18600
CC463	MW	23	12/02/1999	63	2 U	1 UJ	128	44.6	535	32.2	32.6	0.2 U	5 U	* 18900
CC464	MW	11	12/08/1998	63	0.15 U	0.2 U	131	7.9	6.9 U	245	* 8030	0.2 U	4.5 U	* 14400
CC464	MW	11	12/08/1998	24	0.33 U	0.74 U	* 211	17.2	6.9 U	* 1750	737	0.2 U	4.5 U	* 42500
CC464	MW	11	12/08/1998	18	0.36 U	0.56 U	* 262	17.8	6.9 U	* 2340	445	0.2 U	4.5 U	* 39200
CC464	MW	23	12/03/1999	18	2 U	1 UJ	145	11.2	25 U	702	148	0.2 U	5 U	* 20600
CC464	MW	23	12/03/1999	63	2 U	1 UJ	114	5 U	25 U	31.1	* 7450	0.2 U	5 U	* 13400
CC465	MW	11	12/08/1998	51	2.7 J	0.21 J	25.4	0.57 U	6.9 U	14.1	4 J	0.2 U	4.5 U	* 3690

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Groundwater - Total Metals (ug/l)														
CC465	MW	11	12/08/1998	15	2.1 J	0.27 J	20.5	0.34 U	6.9 U	11.3	2.9 J	0.2 U	4.5 U	2990
CC465	MW	11	12/08/1998	9	5	0.2 U	48.1	1.6 U	6.9 U	27.4	8.6 J	0.2 U	4.5 U	* 6870
CC465	MW	23	12/02/1999	9	5.6	1 UJ	46.7	5 U	25 U	48.3	5 U	0.2 U	5 U	* 7230
CC465	MW	23	12/02/1999	51	4.7 J	1 UJ	41.2	5 U	60.9 J	43.4	5 U	0.2 U	5 U	* 6740
CC467	MW	11	12/09/1998	7		1 U		5 U	50 U	15.2	6.2 J	0.2 U	5 U	
CC467	MW	11	12/09/1998	7	1 J		52.6 J							* 9270 J
CC467	MW	11	12/09/1998	42.5	1 U	1 U	50.6	5 U	50 U	16	6 J	0.2 U	5 U	* 9220
CC467	MW	11	12/09/1998	13	1 U	1 U	51	5 U	50 U	16.7	5.8 J	0.2 U	5 U	* 9170
CC467	MW	23	12/02/1999	7	2 U	1 UJ	51.4	5.2	25 U	13.9	5 U	0.2 U	5 U	* 9650
CC467	MW	23	12/02/1999	42.5	2 U	1 UJ	53.4	5 U	25 U	14.9	6.1 J	0.2 U	5 U	* 9510
CC468	MW	11	12/08/1998	11	0.65 U	0.2 U	11.2	0.95 U	29 J	0.75 J	21.4	0.2 U	4.5 U	* 3020
CC468	MW	11	12/08/1998	5	0.69 U	0.2 U	11.6	0.88 U	20.2 J	0.62 J	18.5	0.2 U	4.5 U	* 3020
CC468	MW	23	11/30/1999	5	2 U	1 U	10.9	5 U	34.2 J	0.5 U	5 U	0.2 U	5 U	2900
CC469	MW	11	12/08/1998	13.8	0.72 U	16.1	0.2 J	0.2 U	1040	6.2	764	0.2 U	4.5 U	36.5
CC469	MW	11	12/08/1998	7.8	0.67 U	12.8	0.079 U	0.087 U	825	1.5 J	858	0.2 U	4.5 U	17.4
CC469	MW	23	11/30/1999	10	2 U	7.9	0.5 U	5 U	2420	0.5 U	906	0.2 U	5 U	5 U
CC480	MW	23	12/01/1999	12.7	12.5	3.7	0.5 U	5 U	133	5.1	13.9	0.2 U	5 U	87.6
CC481	MW	11	12/09/1998	17.5	1.6 J	1 U	43.4	5 U	50 U	6.3	5 U	0.2 U	5 U	* 6040
CC481	MW	11	12/09/1998	11.5	1.6 J	1 U	44.5	5 U	50 U	7.6	5 U	0.2 U	5 U	* 6190
CC481	MW	23	12/01/1999	11.5	2 U	1 U		5 U	25 U		5 U	0.2 U	5 U	
CC481	MW	23	12/01/1999	11.5			20.4			16.9				2650
Groundwater - Dissolved Metals (ug/l)														
CC1490	MW	12	04/02/1993			2 U	* 579			* 420				* 93400
CC1490	MW	12	05/02/1993			1 U	* 467			* 357				* 71900
CC1490	MW	12	09/26/1993			40 U	* 296	55		* 481				* 43404
CC1490	MW	12	09/01/1995				* 284			* 370				* 42280
CC1490	MW	12	04/01/1996				* 367			* 682				* 52270
CC1490	MW	12	11/06/1996			35 U	* 344			* 204				* 58200
CC1490	MW	12	04/18/1997				* 183			* 658				* 22300
CC1490	MW	12	10/15/1997				* 201			* 163				* 27600
CC1491	MW	12	04/02/1993			2 U	* 157			67				* 27200
CC1491	MW	12	05/26/1993			1 U	* 159			66				* 24500
CC1491	MW	12	05/25/1994			50 U	* 127	127		* 135		0.2 U		* 11185
CC1491	MW	12	04/01/1996				* 167			* 500				* 20980
CC1491	MW	12	11/06/1996			35 U	* 84			96				* 10610
CC1491		12	04/18/1997				* 170			* 775				15700

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Groundwater - Dissolved Metals (ug/l)														
CC1491	MW	12	10/14/1997				* 105			86				* 15000
CC1492	MW	12	04/02/1993			2 U	* 245			2 U				* 27600
CC1492	MW	12	05/26/1993			1 U	* 251			2				* 28300
CC1492	MW	12	04/01/1996				* 202			38				* 19420
CC1492	MW	12	11/06/1996			35 U	* 196			54				* 21200
CC1492	MW	12	04/17/1997				* 175			* 1170				* 20200
CC1492	MW	12	10/14/1997				* 192			4				* 22400
CC1493	MW	12	04/02/1993			2 U	* 174			2 U				* 22900
CC1493	MW	12	05/26/1993			1 U	* 126			1 U				* 21600
CC1493	MW	12	09/01/1995				* 118			40				* 18710
CC1493	MW	12	04/01/1996				* 129			50				* 19640
CC1493	MW	12	11/06/1996			35 U	* 132			61				* 21940
CC1493	MW	12	04/17/1997				* 202			* 973				* 17000
CC1493	MW	12	10/14/1997				* 139			4				* 24100
CC1494	MW	12	04/02/1993			2 U	* 232			* 320				* 31800
CC1494	MW	12	05/26/1993			1 U	* 182			* 267				* 24700
CC1494	MW	12	09/01/1995			35 U	* 126			* 160				* 16050
CC1494	MW	12	04/01/1996				* 178			* 210				* 20760
CC1494	MW	12	11/06/1996			35 U	28			33				4060
CC1494	MW	12	04/17/1997				* 61			* 286				2550
CC1495	MW	12	05/27/1994			50 U	* 90	12		* 118		0.2 U		* 8910
CC1496	MW	12	09/26/1993			40 U	* 47	5		* 151				3826
CC1496	MW	12	05/25/1994			50 U	* 41	7		* 134		0.2 U		4200
CC1496	MW	12	09/01/1995				* 46			* 170				* 5500
CC1496	MW	12	04/01/1996				* 262			* 909				* 38060
CC1496	MW	12	10/28/1996			35 U	* 313			* 522				* 38040
CC1496	MW	12	04/17/1997				* 382			* 1380				* 50000
CC1496	MW	12	10/14/1997				* 100			71				* 13200
CC1497	MW	12	05/26/1994			50 U	* 329	54		* 813		0.2 U		* 35000
CC1497	MW	12	09/01/1995				* 227			* 730				* 31780
CC1497	MW	12	04/01/1996				* 290			* 1429				* 38890
CC1497	MW	12	11/11/1996			35 U	* 280			* 200				* 25140
CC1497	MW	12	04/17/1997				* 186			* 458				* 20900
CC1497	MW	12	10/14/1997				* 203			* 310				* 26300
CC1498	MW	12	09/26/1993			40 U	* 585	55		* 1986				* 67660
CC1498	MW	12	05/26/1994			50 U	* 67	62		* 2026		0.2 U		* 64740
CC1498	MW	12	09/01/1995			35 U	* 439			* 2070				* 64500

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X
	Shaded Results With (*) Exceed Screening Level By More Than 100X

Groundwater - Dissolved Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC1498	MW	12	04/01/1996				* 892			* 1905				* 145480
CC1498	MW	12	11/06/1996			35 U	* 120			* 1231				* 17270
CC1498	MW	12	04/18/1997				* 215			* 1520				* 23600
CC1498	MW	12	10/15/1997				* 200			* 1730				* 23600
CC1499	MW	12	09/26/1993			40 U	* 289	35		* 3333		0.2 U		* 38607
CC1499	MW	12	05/26/1994			50 U	* 325	29		* 1415		0.2 U		* 34783
CC1499	MW	12	09/01/1995			35 U	* 230			* 840				* 32970
CC1499	MW	12	04/01/1996				* 381			* 500				* 44720
CC1499	MW	12	11/06/1996			35 U	* 304			* 673				* 18860
CC1499	MW	12	04/18/1997				* 112			* 616				* 6470
CC1499	MW	12	10/15/1997				* 98			* 500				* 8440
CC1501	MW	12	09/26/1993			40 U	21	5		* 1801		0.2 U		* 6250
CC1501	MW	12	05/26/1994			50 U	* 53	6		* 2407		0.2 U		* 8000
CC1501	MW	12	09/01/1995			35 U	* 266			* 3270				* 32380
CC1501	MW	12	04/01/1996				* 52			* 1286				* 5110
CC1501	MW	12	11/06/1996			35 U	* 1047			* 200				* 46840
CC1501	MW	12	04/18/1997				* 174			* 574				* 16200
CC1501	MW	12	10/14/1997				* 164			85				* 19400
CC1504	MW	12	09/01/1995			35 U	18			60				1610
CC1504	MW	12	04/01/1996				9			54				900
CC1504	MW	12	10/28/1996			35 U	8			46				721
CC1504	MW	12	04/16/1997				4 U			30 U				183
CC1504	MW	12	10/13/1997				7.9			37				731
CC1505	MW	12	09/01/1995			35 U	* 70			* 290				* 8650
CC1505	MW	12	04/01/1996				* 57			* 6846				* 10420
CC1505	MW	12	10/28/1996			35 U	* 94			* 326				* 14630
CC1505	MW	12	04/16/1997				31			* 432				* 6510
CC1506	MW	12	09/01/1995			35 U	* 254			* 1780				* 23750
CC1506	MW	12	04/01/1996				* 362			* 13836				* 42220
CC1506	MW	12	10/28/1996			35 U	* 704			* 2537				* 79630
CC1506	MW	12	04/16/1997				* 354			* 2950				* 43500
CC1506	MW	12	10/13/1997				* 372			* 2490				* 52600
CC1507	MW	12	09/01/1995			35 U	* 669			* 1590				* 163700
CC1507	MW	12	10/18/1995				* 840			* 1422				* 172400
CC1507	MW	12	04/01/1996				* 490			* 2429				* 35480
CC1507	MW	12	10/28/1996			35 U	* 148			* 2439				* 39690
CC1507	MW	12	04/17/1997				* 120			* 1910				* 37900

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Groundwater - Dissolved Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC1507	MW	12	10/13/1997				* 114			* 1610				* 43500
CC1508	MW	12	09/01/1995			35 U	* 281			* 2030				* 29620
CC1508	MW	12	04/01/1996				* 110			* 818				* 14870
CC1508	MW	12	10/28/1996			35 U	* 699			* 678				* 87780
CC1508	MW	12	04/17/1997				* 154			* 795				* 18600
CC1508	MW	12	10/13/1997				* 545			* 1140				* 89500
CC1509	MW	12	09/01/1995			35 U	* 96			* 530				* 14060
CC1509	MW	12	04/01/1996				* 176			* 350				* 26940
CC1509	MW	12	11/06/1996			35 U	* 574			* 1077				* 90160
CC1509	MW	12	04/17/1997				* 272			* 679				* 31500
CC1509	MW	12	10/13/1997				* 938			* 2360				* 116000
CC1510	MW	12	09/01/1995			35 U	* 42			* 1370				* 5170
CC1510	MW	12	04/01/1996				* 252			* 2333				* 39170
CC1510	MW	12	11/06/1996			35 U	* 176			* 1962				* 25830
CC1510	MW	12	04/17/1997				* 167			* 1620				* 19800
CC1510	MW	12	10/14/1997				* 106			* 2480				* 15700
CC1511	MW	12	09/01/1995			35 U	23			* 600				* 5500
CC1511	MW	12	04/01/1996				* 62			* 591				* 10080
CC1511	MW	12	11/06/1996			35 U	* 252			* 126				* 14850
CC1511	MW	12	04/17/1997				* 247			* 882				* 14000
CC1511	MW	12	10/14/1997				* 157			37				* 15600
CC1512	MW	12	09/01/1995			35 U	2 U			70				850
CC1512	MW	12	04/01/1996				15			* 143				3240
CC1512	MW	12	11/06/1996			35 U	* 60			* 269				* 10230
CC1512	MW	12	04/17/1997				* 78			* 799				* 5780
CC1512	MW	12	10/14/1997				* 39			* 240				* 5830
CC1513	MW	12	09/01/1995			35 U	* 147			* 1890				* 54580
CC1513	MW	12	04/01/1996				* 200			* 2190				* 45560
CC1513	MW	12	11/06/1996			35 U	* 180			* 692				* 44340
CC1513	MW	12	04/18/1997				* 181			* 1930				* 27900
CC1513	MW	12	10/15/1997				* 207			* 970				* 41200
CC1514	MW	12	09/01/1995			35 U	* 110			* 3990				* 18030
CC1514	MW	12	04/01/1996				* 124			* 4512				* 15090
CC1514	MW	12	11/06/1996			35 U	* 574			* 5222				* 105190
CC1514	MW	12	04/18/1997				* 216			* 3810				* 20400
CC1514	MW	12	10/14/1997				* 203			* 5780				* 53500
CC1515	MW	12	09/01/1995			35 U	* 212			* 1060				* 27260

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Groundwater - Dissolved Metals (ug/l)														
CC1515	MW	12	04/01/1996				* 105			* 1095				* 13150
CC1515	MW	12	11/06/1996			35 U	* 120			* 1038				* 18640
CC1515	MW	12	04/18/1997				* 56			* 937				* 7000
CC1515	MW	12	10/15/1997				* 83			* 950				* 12500
CC452	MW	11	12/05/1998	13.5	1 U	1 U	* 42.8	5 U	50 U	59.7	13.5	0.2 U	5 U	* 5180
CC452	MW	23	12/02/1999	13.5	2 U	1 U	22.6	5 U	25 U	35.5	5 U	0.2 U	5 U	2500
CC453	MW	11	12/07/1998	32.5	0.2 U	0.43 U	* 224	26.1	6.9 U			0.2 UJ		* 35800
CC453	MW	11	12/07/1998	32.5						* 326	14.1		19.5	
CC453	MW	11	12/07/1998	18	0.21 U	0.65 U	* 220	26	8.5 J	* 298	13.3	0.2 UJ	4.5 U	* 35100
CC453	MW	11	12/07/1998	12	0.23 U	0.68 U	* 224	25.8	6.9 U	* 362	16.5	0.2 UJ	4.5 U	* 36000
CC453	MW	23	12/02/1999	12	2 U	1 U	* 176	20.6	25 U	* 487	5 U	0.2 U	5 U	* 27200
CC453	MW	23	12/02/1999	32.5	2 U	1 U	* 178	19.7	25 U	* 287 J	5 U	0.2 U	5 U	* 27000
CC456	MW	11	12/09/1998	28	2.5 J	1 U	4.5	5 U	50 U	4.9	5 U	0.2 U	5 U	969
CC456	MW	11	12/09/1998	14	2.4 J	1 U	4.5	5 U	50 U	5	5 U	0.2 U	5 U	970
CC456	MW	11	12/09/1998	8	2.4 J	1 U	4.5	5 U	50 U	4.9	5 U	0.2 U	5 U	978
CC456	MW	23	12/02/1999	8	2 U	1.8 J	5.2	5 U	25 U	5.8	5 U	0.2 U	5 U	1040
CC456	MW	23	12/02/1999	8	2 U	1.4 J	5.2	5 U	25 U	5.6	5 U	0.2 U	5 U	1030
CC459	MW	11	12/08/1998	45.7	0.75 U	0.56 J	* 244	24.1 J	6.9 U	8.5	32.7	0.2 U	4.5 U	* 40400
CC459	MW	11	12/08/1998	22.8	0.69 U	0.56 J	* 240	24.4 J	6.9 U	8.6	59.8	0.2 U	4.5 U	* 39400
CC459	MW	11	12/08/1998	16.8	0.95 U	0.79 J	* 251	25.1 J	6.9 U	9.4	4.7 J	0.2 U	4.5 U	* 41800
CC459	MW	23	12/03/1999	45.7	2.2 J	1 U	* 70.3	7.6	25 U	2.6	7.6 J	0.2 U	5 U	* 10800
CC459	MW	23	12/03/1999	16.8	2.2 J	1 U	* 69.4	7.3	25 U	2.5	5 U	0.2 U	5 U	* 10800
CC460	MW	11	12/07/1998	47.6	1.6 J	0.23 U	* 59.3	1.7 J	6.9 U	9.7	5.8 J	0.2 UJ	4.5 U	* 7340
CC460	MW	11	12/07/1998	13.8	1.7 J	0.41 U	* 51.7	2.4 J	6.9 U	11.4	3.6 J	0.2 UJ	4.5 U	* 6580
CC460	MW	11	12/07/1998	7.8	2 J	0.24 U	* 44.8	0.91 J	6.9 U	9.2	4.6 J	0.2 UJ	4.5 U	* 5650
CC460	MW	23	12/03/1999	7.8	2 U	1 U	* 45.2	5 U	25 U	7.6	5 U	0.2 U	5 U	* 5990
CC460	MW	23	12/03/1999	47.6	2 U	1 U	* 53.4	5 U	25 U	9.3	5 U	0.2 U	5 U	* 7030
CC462	MW	11	12/08/1998	13	1.2 U		* 186			* 216		0.2 U	4.5 U	* 37500
CC462	MW	11	12/08/1998	13		0.58 J		0.78 UJ	28.8 U		1090			
CC462	MW	11	12/08/1998	7	1.2 U	0.52 J	* 186	3 UJ	129	* 243	1090	0.2 U	4.5 U	* 37800
CC462	MW	23	12/04/1999	9	2 U	1 U	* 131	5 U	149	* 182	896	0.2 U	5 U	* 34400
CC462	MW	23	12/04/1999	32	2 U	1 U	* 119	5 U	94.7 J	* 180	803	0.2 U	5 U	* 31500
CC463	MW	11	12/07/1998	63	0.61 U	0.2 U	* 152	41.4	6.9 U	15.4	10.3	0.2 UJ	4.5 U	* 20500
CC463	MW	11	12/07/1998	13	0.62 U	0.38 U	* 156	44.2	60.8 J	20	8.4 J	0.2 UJ	4.5 U	* 20200
CC463	MW	11	12/07/1998	7	0.53 U	0.56 U	* 146	21.2	32.5 J	8.2	24	0.2 UJ	4.5 U	* 20100
CC463	MW	23	12/02/1999	9	2 U	1 U	* 120	28.1	25 U	6.8	5 U	0.2 U	5 U	* 17800
CC463	MW	23	12/02/1999	63	2 U	1 U	* 127	41	25 U	16.1	5 U	0.2 U	5 U	* 18200

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Groundwater - Dissolved Metals (ug/l)														
CC464	MW	11	12/08/1998	63	0.3 U	0.33 J	* 129	7.7 J	6.9 U	* 241	* 7510	0.2 U	4.5 U	* 14200
CC464	MW	11	12/08/1998	24	0.4 U	0.75 U	* 258	19.1	88.3 J	* 2120	743	0.2 U	4.5 U	* 40200
CC464	MW	11	12/08/1998	18	0.42 U	0.58 U	* 258	18.5	6.9 U	* 2280	459	0.2 U	* 527	* 40500
CC464	MW	23	12/03/1999	18	2 U	1 U	* 147	10.1	25 U	* 693 J	144	0.2 U	5 U	* 19900
CC464	MW	23	12/03/1999	63	2 U	1 UJ	* 116	5 U	25 U	28.7 J	* 6910	0.39	5 U	* 12600
CC465	MW	11	12/08/1998	51	2.6 J	0.41 J	23.8	0.65 UJ	136	12.8	6.1 J	0.2 U	4.5 U	3600
CC465	MW	11	12/08/1998	15	2.2 J	0.56 J	21.1	0.54 UJ	6.9 U	11	4 J	0.2 U	4.5 U	3050
CC465	MW	11	12/08/1998	9	5	0.2 U	* 47.7	1.7 UJ	6.9 U	26.1	9.6 J	0.2 U	4.5 U	* 6790
CC465	MW	23	12/02/1999	9	5.7	1 U	* 49.1	5 U	25 U	46.5	5 U	0.2 U	5 U	* 7550
CC465	MW	23	12/02/1999	51	4.6 J	1 U	* 40.7	5 U	25 U	35.7	5 U	0.2 U	5 U	* 5670
CC467	MW	11	12/09/1998	7	1 U	1 U		5 U	50 U	15.3	6.5 J	0.2 U	5 U	* 9340
CC467	MW	11	12/09/1998	7			* 52							
CC467	MW	11	12/09/1998	42.5	1 U	1 U	* 50.7	5 U	50 U	15.9	6.1 J	0.2 U	5 U	* 9400
CC467	MW	11	12/09/1998	13	1 U	1 U	* 50.1	5 U	50 U	16	6.3 J	0.2 U	5 U	* 9210
CC467	MW	23	12/02/1999	7	2 U	1 U	* 54.6	5 U	25 U	14.7	5 U	0.2 U	5 U	* 9430
CC467	MW	23	12/02/1999	42.5	2 U	1 U	* 54.4	5 U	25 U	14	5 U	0.2 U	5 U	* 9580
CC468	MW	11	12/08/1998	11	0.66 U	0.32 J	10.9	1 UJ	6.9 U	0.25 U	16.8	0.2 U	4.7 J	2880
CC468	MW	11	12/08/1998	5	0.67 U	0.2 U	11.5	0.99 UJ	13.3 U	0.25 U	19.8	0.2 U	4.5 U	2890
CC468	MW	23	11/30/1999	5	2 U	1 U	10.3	5 U	25 U	0.5 U	5 U	0.2 U	5 U	2830
CC469	MW	11	12/08/1998	13.8	0.9 U	14	0.15 J	0.087 U	747	0.04 U	814	0.2 U	4.5 U	33.7
CC469	MW	11	12/08/1998	7.8	0.73 U	12.2	0.079 U	0.087 U	718	0.19 U	865	0.2 U	4.5 U	16.1
CC469	MW	23	11/30/1999	10	2 U	8.2	0.54 J	5 U	2250	0.5 U	918	0.2 U	5 U	5 U
CC480	MW	23	12/01/1999	12.7	12.1	3.1	0.5 U	5 U	25 U	0.5 U	5 U	0.2 U	5 U	103
CC481	MW	11	12/09/1998	17.5	1.5 J	1 U	* 39.2	5 U	50 U	4.7	5 U	0.2 U	5 U	* 5750
CC481	MW	11	12/09/1998	11.5	1.6 J	1 U	* 40.6	5 U	50 U	5.9	5 U	0.2 U	5 U	* 5820
CC481	MW	23	12/01/1999	11.5	2 U	1 U	20.5	5 U	25 U	16.2	5 U	0.2 U	5 U	2600
Surface Water - Total Metals (ug/l)														
CC17	RV	5	10/05/1991				8.6			35				1630
CC17	RV	11	11/14/1998		7.6	1 U	19.5	5 U	372	127	101	0.2 U	5 U	2730
CC19	SP	4	05/17/1991				7.2			37				1360
CC19	SP	5	10/05/1991				6.6			37				1230
CC20	SP	5	10/05/1991				* 396			* 1590				* 35400
CC23	RV	4	05/15/1991				5.7			38				923
CC23	RV	4	05/17/1991				6			30				880
CC23	RV	4	05/18/1991				10.5			* 1530				1870
CC23	RV	5	10/04/1991				10.1			57				* 3570

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC23	RV	5	10/05/1991				18.6			52				* 3560
CC283	RV	2	11/09/1997		4.7 J	0.51 U	7.8	1.8 J	132	66.3	67.3	0.1 U	0.22 U	1190
CC283	RV	2	01/13/1998		5.4	0.34 J	12.7	1.8 J	144	92	81.4	0.1 UJ	0.11 U	1980
CC283	RV	3	05/15/1998		1.5	1 U	2.5	3 U	92.8 U	30.3	34.6	0.2 U	0.3 U	368
CC284	RV	2	11/09/1997		4.8 J	0.56 U	7.7	1.7 J	140	70.7	67.5	0.1 U	0.22 U	1290
CC284	RV	2	01/13/1998		5.7	0.37 J	13.9	2.1 J	164	118	84.8	0.1 UJ	0.11 U	2010
CC284	RV	4	05/17/1991				3.3			21				475
CC284	RV	5	10/05/1991				7.6			29				1290
CC284	RV	7	10/27/1993				6.3			45				1140
CC284	RV	7	11/30/1993				8.5			43				1640
CC284	RV	7	12/17/1993				10.2			36				2070
CC284	RV	7	01/20/1994				12			40				2310
CC284	RV	7	02/18/1994				11			36				1920
CC284	RV	7	03/08/1994				15			42				2410
CC284	RV	7	03/24/1994				15			41				2440
CC284	RV	7	04/07/1994				7.9			28				1260
CC284	RV	7	04/19/1994				5			190				695
CC284	RV	7	05/04/1994				3.9			25				585
CC284	RV	7	05/19/1994				3.3			14				470
CC284	RV	7	06/07/1994				5.6			24				725
CC284	RV	7	06/23/1994				5.6			33				743
CC284	RV	7	07/25/1994				6.9			31				984
CC284	RV	7	08/16/1994				7.4			39				1080
CC284	RV	7	09/13/1994				6.2			40				800
CC284	RV	7	10/06/1994				8.8			31				1120
CC284	RV	7	11/16/1994				11			30				1980
CC284	RV	7	12/13/1994				13			31				2480
CC284	RV	7	01/10/1995				18			82				2710
CC284	RV	7	02/09/1995				10.3			28				1680
CC284	RV	7	03/08/1995				7.6			21				1110
CC284	RV	7	03/22/1995				16			42				2190
CC284	RV	7	04/12/1995				6.7			27				1170
CC284	RV	7	04/25/1995				6.2			48				1060
CC284	RV	7	05/10/1995				4			38				433
CC284	RV	7	05/23/1995				3.7			29				422
CC284	RV	7	06/13/1995				3			29				444
CC284	RV	7	06/27/1995				4.1			41				583

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC284	RV	7	07/11/1995				5.1			29				791
CC284	RV	7	07/25/1995				6.2			31				818
CC284	RV	7	08/14/1995				6.7			30				1020
CC284	RV	7	09/13/1995				6.8			30				926
CC284	RV	7	10/18/1995				8.5			46				1300
CC284	RV	7	11/21/1995				4.8			88				820
CC284	RV	7	12/27/1995				7.4			44				1220
CC284	RV	7	01/17/1996				14			208				2100
CC284	RV	7	02/29/1996				6.7			48				1170
CC284	RV	7	03/28/1996				21			* 2720				1800
CC284	RV	7	04/17/1996				* 407			50				687
CC284	RV	3	05/15/1998		1.6	1 U	2.8	3 U			34.3	0.2 U	0.3 U	402
CC284	RV	3	05/15/1998						96.6 U	36.2				
CC285	RV	2	11/09/1997		5	0.35 U	9.6	1.7 J	122	77.6	59.9	0.1 U	0.22 U	1550
CC285	RV	2	01/13/1998		5.3	0.23 J	17.7	2.1 J	171	105	80.5	0.1 UJ	0.11 U	2570
CC285	RV	4	05/17/1991				3.7			24				554
CC285	RV	5	10/05/1991				10.2			34				1890
CC285	RV	7	10/18/1995				11			86				1590
CC285	RV	7	11/21/1995				6.8			212				1040
CC285	RV	7	12/27/1995				9.9			46				1550
CC285	RV	7	01/17/1996				17			122				2490
CC285	RV	7	02/29/1996				8.6			61				1530
CC285	RV	7	03/28/1996				30			* 2920				2270
CC285	RV	7	04/17/1996				6			64				851
CC285	RV	7	05/08/1996				7			54				1050
CC285	RV	7	06/19/1996				3.7			53				539
CC285	RV	7	07/24/1996				7.6			285				989
CC285	RV	7	08/21/1996				9.8			300				1230
CC285	RV	7	09/26/1996				7.9			217				1070
CC285	RV	7	10/29/1996				15			446				2170
CC285	RV	7	11/27/1996				12			62				2500
CC285	RV	7	12/13/1996				25			94				* 3840
CC285	RV	7	01/30/1997				13			60				2100
CC285	RV	7	02/19/1997				16			80				2650
CC285	RV	7	03/26/1997				18			0.082				2730
CC285	RV	7	04/16/1997				15			66				2360
CC285	RV	7	05/15/1997				4.4			1090				765

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC285	RV	7	06/24/1997				2.8			39				466
CC285	RV	7	07/23/1997				4.6			50				767
CC285	RV	7	08/14/1997				8.8			257				1250
CC285	RV	7	09/04/1997				10			60				1390
CC285	RV	7	10/16/1997				9.8			698				1140
CC285	RV	7	11/26/1997				11			292				1490
CC285	RV	7	12/19/1997				23			* 2080				2420
CC285	RV	7	01/22/1998				0.7			2.5				156
CC285	RV	7	02/26/1998				13			60				1830
CC285	RV	7	03/20/1998				13			89				1840
CC285	RV	7	04/23/1998				11			* 1920				1340
CC285	RV	18	10/27/1998							46				1600
CC285	RV	18	11/18/1998				16			120				2400
CC285	RV	18	12/15/1998				20			57				2800
CC285	RV	18	01/20/1999				17			50				2300
CC285	RV	18	03/23/1999				21			130				2800
CC285	RV	18	04/21/1999				10			96				1300
CC285	RV	18	05/05/1999				6			57				920
CC285	RV	18	05/24/1999				7		3700	1400	370			940
CC285	RV	18	06/15/1999				3			110				320
CC285	RV	18	07/08/1999				3.4			28.1				436
CC285	RV	18	08/05/1999				7.4			61.4				865
CC285	RV	18	08/30/1999				9			45.9				1030
CC285	RV	7	05/28/1998				5.4			100				764
CC285	RV	7	06/26/1998				6.1			54				786
CC285	RV	7	07/28/1998				11			62				1140
CC285	RV	7	07/28/1998				10			58				1180
CC285	RV	7	08/26/1998				11			57				1180
CC285	RV	7	08/26/1998				9.6			58				1180
CC285	RV	7	09/24/1998				10			72				1220
CC285	RV	7	10/26/1998				9.6			46				1070
CC285	RV	7	11/25/1998				28			77				* 3860
CC285	RV	7	01/15/1999				16			61				2440
CC285	RV	7	02/23/1999				15			37				1960
CC285	RV	7	03/08/1999				15			43				2280
CC285	RV	3	05/14/1998			[illegible]		2 U				0.2 U	0.2 U	
CC285	RV	3	05/14/1998		1.4		3.3		119	43.1	31			424

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC286	RV	2	11/09/1997		5	0.62 U	13.5	1.9 J	99.6 J	74.1	60	0.1 U	0.22 U	2140
CC286	RV	2	01/16/1998		7.3	0.84 J	20.7	5.3	400	296	135	0.17 J	0.61	2970
CC286	RV	5	10/05/1991				14.5			44				2480
CC286	RV	3	05/15/1998		1.8	1 U	4.9	3 U	106 U	44.6	39.1	0.2 U	0.3 U	660
CC286	RV	11	11/14/1998		8.2	1.1 J	24.4	5 U	379	136	113	0.2 U	5 U	* 3650
CC286	RV	23	12/04/1999		3.7 J	1 U	13	5 U	67.4 J	33.5	69	0.2 U	5 U	2080
CC287	RV	2	11/09/1997		4.7 J	0.33 U	17.8	2.4 J	104	74.7	70.8	0.1 U	0.22 U	2680
CC287	RV	2	01/13/1998		5.4	0.55 J	31	3.7	302	179	118	0.1 UJ	0.11 U	* 4270
CC287	RV	5	10/05/1991				20.8			55				* 3430
CC287	RV	7	10/27/1993				22			56				* 3420
CC287	RV	7	11/30/1993				22			62				* 4050
CC287	RV	7	12/17/1993				33			56				* 5180
CC287	RV	7	01/20/1994				38			59				* 5050
CC287	RV	7	02/18/1994				30			52				* 4620
CC287	RV	7	03/08/1994				26			55				* 4460
CC287	RV	7	03/24/1994				26			53				* 4600
CC287	RV	7	04/07/1994				18			47				2350
CC287	RV	7	04/19/1994				8.6			383				1170
CC287	RV	7	05/04/1994				8.2			42				1160
CC287	RV	7	05/19/1994				7.7			34				1000
CC287	RV	7	06/07/1994				12			39				1520
CC287	RV	7	06/23/1994				14			49				1690
CC287	RV	7	07/25/1994				18			55				2390
CC287	RV	7	08/16/1994				19			62				2850
CC287	RV	7	09/13/1994				21			53				2880
CC287	RV	7	10/16/1994				21			50				* 3430
CC287	RV	7	11/16/1994				32			59				* 5500
CC287	RV	7	12/13/1994				38			54				* 6640
CC287	RV	7	01/10/1995				39			137				* 6320
CC287	RV	7	02/09/1995				19			44				* 3230
CC287	RV	7	03/08/1995				16			31				2530
CC287	RV	7	03/22/1995				24			66				* 3970
CC287	RV	7	04/12/1995				15			46				2550
CC287	RV	7	04/25/1995				12			36				2100
CC287	RV	7	05/10/1995				7.8			82				905
CC287	RV	7	05/23/1995				7			33				786
CC287	RV	7	06/13/1995				6.8			37				919

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X
	Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC287	RV	7	06/27/1995				8.4			36				1220
CC287	RV	7	07/11/1995				12			44				1690
CC287	RV	7	07/25/1995				14			45				1770
CC287	RV	7	08/14/1995				18			58				2490
CC287	RV	7	09/13/1995				20			52				2780
CC287	RV	7	10/18/1995				21			424				* 3020
CC287	RV	7	11/21/1995				13			680				1960
CC287	RV	7	12/27/1995				18			108				2500
CC287	RV	7	01/17/1996				27			254				* 3830
CC287	RV	7	02/29/1996				15			282				2370
CC287	RV	7	03/28/1996				16			98				2230
CC287	RV	7	04/17/1996				9.5			136				1230
CC287	RV	7	05/08/1996				12			219				1660
CC287	RV	7	06/19/1996				5.8			74				836
CC287	RV	7	07/24/1996				14			132				1550
CC287	RV	7	08/21/1996				24			314				* 3730
CC287	RV	7	09/26/1996				23			588				2770
CC287	RV	7	10/29/1996				28			408				* 3840
CC287	RV	7	11/27/1996				29			76				* 4480
CC287	RV	7	12/13/1996				39			100				* 5500
CC287	RV	7	01/30/1997				25			71				* 3500
CC287	RV	7	02/21/1997				27			91				* 3980
CC287	RV	7	03/26/1997				25			0.12				* 3760
CC287	RV	7	04/16/1997				23			112				* 3340
CC287	RV	7	05/15/1997				6.3			1160				910
CC287	RV	7	06/24/1997				5			46				726
CC287	RV	7	07/23/1997				10			564				1330
CC287	RV	7	08/14/1997				15			94				1900
CC287	RV	7	09/04/1997				19			325				2540
CC287	RV	7	10/16/1997				22			438				2850
CC287	RV	7	11/26/1997				19			124				2750
CC287	RV	7	12/19/1997				26			288				* 3440
CC287	RV	7	01/22/1998				25			84				* 3320
CC287	RV	7	02/26/1998				25			62				* 3460
CC287	RV	7	03/20/1998				21			76				2730
CC287	RV	7	04/23/1998				15			* 2090				1910
CC287	RV	7	05/07/1998				4.2			198				544

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC287	RV	7	05/28/1998				7.2			106				958
CC287	RV	7	05/28/1998				7			102				977
CC287	RV	7	06/26/1998				9.8			56				1200
CC287	RV	7	07/28/1998				17			62				1700
CC287	RV	7	08/26/1998				18			59				2080
CC287	RV	7	09/24/1998				17			66				2220
CC287	RV	7	10/01/1998				19			64				2220
CC287	RV	7	10/08/1998				20			61				2680
CC287	RV	7	10/26/1998				18			47				2290
CC287	RV	7	11/25/1998				52			97				* 6950
CC287	RV	7	01/15/1999				25			68				* 3730
CC287	RV	7	02/23/1999				30			46				* 3710
CC287	RV	7	03/08/1999				28			46				* 3870
CC287	RV	3	05/14/1998		1.5	2 U	5.1	2 U	107	48.8	35	0.2 U	0.2 U	641
CC288	RV	2	11/09/1997		5	0.39 U	18.2	2.4 J	124	77.5	69.6	0.1 U	0.22 U	2750
CC288	RV	2	01/13/1998		5	0.33 J	31.5	2.5 J	187	115	108	0.1 UJ	0.11 U	* 4410
CC288	RV	18	10/26/1998				18			43				2300
CC288	RV	18	10/26/1998				19			42				2200
CC288	RV	18	11/18/1998							49				* 3900
CC288	RV	18	12/15/1998				31			52				* 4500
CC288	RV	18	12/28/1998				32			230				* 4200
CC288	RV	18	03/23/1999				26			120				* 3600
CC288	RV	18	04/19/1999				15			370				1900
CC288	RV	18	05/05/1999				9		120	55	82			1300
CC288	RV	18	05/24/1999				11		5400	* 2000	560			1400
CC288	RV	18	05/27/1999				5		780	250	110			660
CC288	RV	18	06/02/1999				5		230	99	51			570
CC288	RV	18	06/15/1999				4			150				470
CC288	RV	18	07/08/1999				5.4			33.2				664
CC288	RV	18	08/05/1999				12.6			58.9				1390
CC288	RV	18	08/30/1999				15			50.5				1780
CC288	RV	3	05/14/1998		1.4	2 U	5.2	2 U	108	51.1	37	0.2 U	0.2 U	675
CC288	RV	3	05/17/1998		2 U	0.23 U	6.7 J	1.2 J	106 J		42.9 J	0.16 U	0.042 U	
CC288	RV	11	11/14/1998		6.9	1 U	34.2	5 U	170	83.5 J	105	0.2 U	5 U	* 4620
CC356	AD	3	05/15/1998		0.5 U	0.2 U	0.3 J	0.8 J	672	5	19.4	0.2 U		208
CC357	SP	3	05/16/1998		1 U	0.6 U	52.9 J	6.1 J		198		0.2 U	0.1 U	
CC454	RV	11	11/13/1998		11.5	2.2	15.7	11.5	1590	715	186	0.2	4.5 U	1910

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC454	RV	23	12/02/1999		3.8 J	1 UJ	7.9	5 U	111	27.8	63.2	0.2 U	5 U	1270
CC455	RV	11	11/13/1998					10.4	1280		154		4.5 U	
CC455	RV	11	11/13/1998		11.2	2	17.5			550		0.31		2120
CC455	RV	11	11/14/1998		7.7	1 U	17.8	5 U	346	114 J	104	0.2 U	5 U	2470
CC455	RV	11	12/07/1998		5.2	0.49 U	19.6	1.5 J	124	52.5	108	0.2 UJ	4.5 U	2970
CC455	RV	23	12/02/1999		3.9 J	1 UJ	9.7	5 U	89.5 J	30.6	59.8	0.2 U	5 U	1580
CC457	RV	11	11/14/1998		7	1 U	36	5 U	285	117	117	0.2 U	5 U	* 4760
CC457	RV	23	12/02/1999		3.9 J	1 U	18.3	5 U	76.7 J	40.2	76.5	0.2 U	5 U	2730
CC482	RV	11	11/14/1998		6.6	1 U	34.4	5 U	177	83.2	106	0.2 U	5 U	* 4590
CC482	RV	11	12/09/1998		5.7	1 U	36.8	5 U	106	65.2	112	0.2 U	5 U	* 5400
CC482	RV	23	12/01/1999		3.9 J	1 U	20	5 U	56.6 J	36.3	62.9	0.2 U	5 U	* 3130
CC800	OF	8	03/24/1998		45 U	40 U	20.8	14.8		914	280	0.58	4 U	2650
CC811	OF	8	04/02/1996				1.58	5 U		5.66	125	0.2 U	1 U	287
CC811	OF	8	03/24/1998		45 U	40 U	4.1	3 U		25 U	8.11	0.2 U	4 U	394
CC811	OF	8	01/31/1994				23			37				1430
CC811	OF	8	02/28/1994				5			30				468
CC811	OF	8	03/31/1994				6			40				526
CC811	OF	8	04/30/1994				7			34				525
CC811	OF	8	05/31/1994				6			121				723
CC811	OF	8	06/30/1994				5			50				489
CC811	OF	8	07/31/1994				6			47				425
CC811	OF	8	08/31/1994				5			37				313
CC811	OF	8	09/30/1994				4			40				380
CC811	OF	8	10/31/1994				5			37				437
CC811	OF	8	11/30/1994				6			33				498
CC811	OF	8	12/31/1994				4			36				407
CC811	OF	8	01/31/1995				4			42				399
CC811	OF	8	02/28/1995				6			37				888
CC811	OF	8	03/31/1995				7			52				765
CC811	OF	8	04/30/1995				7			39				825
CC811	OF	8	05/31/1995				7			46				640
CC811	OF	8	06/30/1995				5			50				466
CC811	OF	8	07/31/1995				3			43				405
CC811	OF	8	08/31/1995				3			28				455
CC811	OF	8	09/30/1995				5			27				529
CC811	OF	8	10/31/1995				5 U			40				651
CC811	OF	8	11/30/1995				5			87				412

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
CC811	OF	8	12/31/1995				7			46				444
CC811	OF	8	01/31/1996				4			33				435
CC811	OF	8	02/29/1996				6			55				664
CC811	OF	8	03/31/1996				4			55				1150
CC811	OF	8	04/30/1996				6			55				1790
CC811	OF	8	05/31/1996				10			55				1440
CC811	OF	8	06/30/1996				10			50				700
CC811	OF	8	07/31/1996				6			40				509
CC811	OF	8	08/31/1996				4			46				500
CC811	OF	8	09/30/1996				5			47				609
CC811	OF	8	10/31/1996				4			33				429
CC811	OF	8	11/30/1996				3			46				407
CC811	OF	8	01/31/1997				3			31				324
CC811	OF	8	02/28/1997				3			26				277
CC811	OF	8	03/31/1997				5			41				879
CC811	OF	8	04/30/1997				16			62				2140
CC811	OF	8	05/31/1997				10			599				868
CC811	OF	8	06/30/1997				9			50				1630
CC811	OF	8	07/31/1997				2 U			43				479
CC811	OF	8	08/31/1997				3			48				386
CC811	OF	8	09/30/1997				2 U			45				382
CC811	OF	8	10/31/1997				3			43				429
CC811	OF	8	11/30/1997				2 U			42				398
CC811	OF	8	12/31/1997				2 U			44				277
CC811	OF	8	01/31/1998				2 U			37				270
CC811	OF	8	02/28/1998				2 U			47				518
CC811	OF	8	03/31/1998				4			69				456
CC811	OF	8	04/30/1998				3			45				425
CC811	OF	8	05/31/1998				2 U			54				473
CC811	OF	8	06/30/1998				42			355				
CC811	OF	8	01/15/1994				4							322
CC811	OF	8	02/15/1994				7							551
CC811	OF	8	03/15/1994				4							381
CC811	OF	8	04/15/1994				6							508
CC811	OF	8	05/15/1994				6							470
CC811	OF	8	06/15/1994				5							629
CC811	OF	8	07/15/1994				5							443

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC811	OF	8	08/15/1994				5							391
CC811	OF	8	09/15/1994				4							297
CC811	OF	8	10/15/1994				4							334
CC811	OF	8	11/15/1994				4							418
CC811	OF	8	12/15/1994				5							406
CC811	OF	8	01/15/1995				3							371
CC811	OF	8	02/15/1995				4							
CC811	OF	8	03/15/1995				4							431
CC811	OF	8	04/15/1995				6							735
CC811	OF	8	05/15/1995				6							639
CC811	OF	8	06/15/1995				5							699
CC811	OF	8	07/15/1995				3							563
CC811	OF	8	08/15/1995				2							445
CC811	OF	8	09/15/1995				1							389
CC811	OF	8	10/15/1995				3							436
CC811	OF	8	11/15/1995				5 U							440
CC811	OF	8	12/15/1995				4							561
CC811	OF	8	01/15/1996				4							339
CC811	OF	8	02/15/1996				3							397
CC811	OF	8	03/15/1996				3							410
CC811	OF	8	04/15/1996				2							523
CC811	OF	8	05/15/1996				4							736
CC811	OF	8	06/15/1996				9							1650
CC811	OF	8	07/15/1996				7							1010
CC811	OF	8	08/15/1996				4							628
CC811	OF	8	09/15/1996				3							466
CC811	OF	8	10/15/1996				3							473
CC811	OF	8	11/15/1996				3							492
CC811	OF	8	12/15/1996											413
CC811	OF	8	01/15/1997				3							364
CC811	OF	8	02/15/1997				3							299
CC811	OF	8	03/15/1997				2 U							270
CC811	OF	8	04/15/1997				3							529
CC811	OF	8	05/15/1997				11							1360
CC811	OF	8	06/15/1997				6							610
CC811	OF	8	07/15/1997				4							633
CC811	OF	8	08/15/1997				2 U							391

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC811	OF	8	09/15/1997				2 U							323
CC811	OF	8	10/15/1997				2 U							364
CC811	OF	8	11/15/1997				3							389
CC811	OF	8	12/15/1997				2 U							317
CC811	OF	8	01/15/1998				2 U							244
CC811	OF	8	02/15/1998				2 U							246
CC811	OF	8	03/15/1998				2 U							315
CC811	OF	8	04/15/1998				2 U							417
CC811	OF	8	05/15/1998				2							404
CC811	OF	8	06/15/1998				2 U							410

Surface Water - Dissolved Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC17	RV	5	10/05/1991				8			7				1450
CC17	RV	11	11/14/1998		6.3	1.4 J	18.1	5 U	55.6 J	30.1	89.6	0.2 U	5 U	2620
CC19	SP	4	05/17/1991				5.6			14				1420
CC19	SP	5	10/05/1991				6.4			11				1160
CC20	SP	5	10/05/1991				* 390			* 1480				3830
CC23	RV	4	05/15/1991				5.5			13				990
CC23	RV	4	05/17/1991				4.5			5				905
CC23	RV	4	05/18/1991				4.8			13				929
CC23	RV	5	10/04/1991				19			18				3630
CC23	RV	5	10/05/1991				19.9			20				3660
CC283	RV	2	11/09/1997		4.2	0.25	8.62	1.1	45.7	41.7	66.5	0.2 U	0.03 U	1220
CC283	RV	2	01/13/1998		4.9 J	0.12 U	12.5	0.96 J	26.1	45.7	70.6	0.1 UJ	0.11 U	1830
CC283	RV	3	05/15/1998		1.3	1 U	2.4	3 U	47	16.7	30.6	0.2 U	0.3 U	327
CC284	RV	2	11/09/1997		4.3	0.24	8.98	1.1	43.7	42.8	65.5	0.2 U	0.03 U	1240
CC284	RV	2	01/13/1998		4.8 J	0.12 U	13.3	1 J	36.8	47	77.9	0.1 UJ	0.11 U	2030
CC284	RV	4	05/17/1991				2.5			4				485
CC284	RV	5	10/05/1991				7.5			6				999
CC284	RV	7	10/27/1993				6.3			15				1130
CC284	RV	7	11/30/1993				8.5			15				1650
CC284	RV	7	12/17/1993				10.7			18				2130
CC284	RV	7	01/20/1994				12			18				2310
CC284	RV	7	02/18/1994				12			13				1970
CC284	RV	7	03/08/1994				14			25				2440
CC284	RV	7	03/24/1994				15			25				2470
CC284	RV	7	04/07/1994				8.3			18				1280

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC284	RV	7	04/19/1994				4.2			13				608
CC284	RV	7	05/04/1994				4.3			16				586
CC284	RV	7	05/19/1994				2.8			15				480
CC284	RV	7	06/07/1994				5.1			17				728
CC284	RV	7	06/23/1994				5.6			20				728
CC284	RV	7	07/25/1994				6			18				969
CC284	RV	7	08/16/1994				7.2			17				1050
CC284	RV	7	09/13/1994				5.8			10				709
CC284	RV	7	10/06/1994				7.1			10				1060
CC284	RV	7	11/16/1994				12			14				1980
CC284	RV	7	12/13/1994				15			14				2460
CC284	RV	7	01/10/1995				16			16				2660
CC284	RV	7	02/09/1995				9.8			17				1690
CC284	RV	7	03/08/1995				6.8			15				1120
CC284	RV	7	03/22/1995				12			26				2040
CC284	RV	7	04/12/1995				6.7			1.5 U				1140
CC284	RV	7	04/25/1995				5.8			18				964
CC284	RV	7	05/10/1995				4			12				395
CC284	RV	7	05/23/1995				3.4			18				419
CC284	RV	7	06/13/1995				2.9			23				435
CC284	RV	7	06/27/1995				3.6			16				580
CC284	RV	7	07/11/1995				5			20				787
CC284	RV	7	07/25/1995				5.9			22				818
CC284	RV	7	08/14/1995				6.5			19				1010
CC284	RV	7	09/13/1995				6.9			14				893
CC284	RV	7	10/18/1995				8.1			16				1280
CC284	RV	7	11/21/1995				4.3			16				788
CC284	RV	7	12/27/1995				7.8			26				1240
CC284	RV	7	01/17/1996				15			52				2070
CC284	RV	7	02/29/1996				6.7			27				1220
CC284	RV	7	03/28/1996				8.7			* 188				1350
CC284	RV	7	04/17/1996				* 408			31				688
CC284	RV	3	05/15/1998		1.4	1 U	2.7	3 U		18.8		0.2 U	0.3 U	
CC284	RV	3	05/15/1998						37		30			355
CC285	RV	2	11/09/1997		4.4	0.21	10.7	1.2	33.8	47.7	58.7	0.2 U	0.03 U	1480
CC285	RV	2	01/13/1998		4.7 J	0.12 U	17.7	0.83 J	16.8	39.5	67.6	0.1 UJ	0.11 U	2570
CC285	RV	4	05/17/1991				2.7			4				555

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC285	RV	5	10/05/1991				10.1			8				1740
CC285	RV	7	10/18/1995				11			24				1630
CC285	RV	7	11/21/1995				6.2			40				1010
CC285	RV	7	12/27/1995				10			35				1580
CC285	RV	7	01/17/1996				17			28				2560
CC285	RV	7	02/29/1996				9			38				1540
CC285	RV	7	03/28/1996				14			* 578				1610
CC285	RV	7	04/17/1996				6			37				836
CC285	RV	7	05/08/1996				7.2			36				1120
CC285	RV	7	06/19/1996				3.7			28				548
CC285	RV	7	07/24/1996				7.2			58				914
CC285	RV	7	08/21/1996				9.3			89				1150
CC285	RV	7	09/26/1996				8.3			94				1030
CC285	RV	7	10/29/1996				14			29				2050
CC285	RV	7	11/27/1996				11			46				2480
CC285	RV	7	12/13/1996				24			54				3900
CC285	RV	7	01/30/1997				14			37				2120
CC285	RV	7	02/19/1997				17			46				2730
CC285	RV	7	03/26/1997				17			53				2760
CC285	RV	7	04/16/1997				15			38				2430
CC285	RV	7	06/24/1997				3.1			27				505
CC285	RV	7	07/23/1997				5			36				784
CC285	RV	7	08/14/1997				8.5			80				1230
CC285	RV	7	09/04/1997				11			43				1440
CC285	RV	7	10/16/1997				6.4			45				736
CC285	RV	7	11/26/1997				9.5			70				1450
CC285	RV	7	12/19/1997				14			61				1760
CC285	RV	7	01/22/1998				0.9			1.5				151
CC285	RV	7	02/26/1998				14			38				1890
CC285	RV	7	03/20/1998				13			39				1840
CC285	RV	7	04/23/1998				6.5			91				917
CC285	RV	18	10/27/1998				13			31				1660
CC285	RV	18	11/18/1998				16			22				2290
CC285	RV	18	12/15/1998				19			22				2790
CC285	RV	18	01/20/1999				16			24				2250
CC285	RV	18	03/23/1999				20			37				2920
CC285	RV	18	04/21/1999				8.9			24				1290

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Dissolved Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC285	RV	18	05/05/1999				6			19				956
CC285	RV	18	05/24/1999				4.2		22	25	0.41			505
CC285	RV	18	06/15/1999				2.4			19				307
CC285	RV	18	07/08/1999				3			16				457
CC285	RV	18	08/05/1999				7			21				944
CC285	RV	18	08/30/1999				9			27				1130
CC285	RV	7	05/28/1998				5.2			35				739
CC285	RV	7	06/26/1998				6.4			34				810
CC285	RV	7	07/28/1998				10			43				1150
CC285	RV	7	07/28/1998				10			41				1150
CC285	RV	7	08/26/1998				11			36				1210
CC285	RV	7	08/26/1998				9.8			34				1220
CC285	RV	7	09/24/1998				10			46				1230
CC285	RV	7	10/26/1998				9.4			30				1080
CC285	RV	7	11/25/1998				28			43				3950
CC285	RV	7	01/15/1999				17			34				2420
CC285	RV	7	02/23/1999				14			24				1950
CC285	RV	7	03/08/1999				14			30				2280
CC285	RV	3	05/14/1998			2 U		2 U				0.2 U	0.2 U	
CC285	RV	3	05/14/1998		1.3		3.4		46	61.2	30			475
CC286	RV	2	11/09/1997		4.4	0.21	15.1	1.4	25.9	50.9	62.2	0.2 U	0.03 U	2090
CC286	RV	2	01/16/1998		4.4 J	0.12 U	19.2	1.1 J	17.7	39.5	89.9	0.1 UJ	0.11 U	2940
CC286	RV	5	10/05/1991				15.8			11				2490
CC286	RV	3	05/15/1998		1.6	1 U	4.9	3 U	25.3	23.5	33	0.2 U	0.3 U	588
CC286	RV	11	11/14/1998				23.9	5 U	50 U		102		5 U	3500
CC286	RV	23	12/04/1999		3.7 J	1 U	12.8	5 U	41.2 J	22	70.2	0.2 U	5 U	2180
CC287	RV	2	11/09/1997		4.3	0.19	19.8	1.3	20	50.8	68	0.2 U	0.03 U	2610
CC287	RV	2	01/13/1998		4.1 J	0.12 U	30.3	0.89 J	19.2	24.7	95.5	0.1 UJ	0.11 U	4200
CC287	RV	5	10/05/1991				21.6			20				3440
CC287	RV	7	10/27/1993				26			55				3470
CC287	RV	7	11/30/1993				26			34				3980
CC287	RV	7	12/17/1993				31			46				* 5440
CC287	RV	7	01/20/1994				33			38				* 5240
CC287	RV	7	02/18/1994				28			36				* 4740
CC287	RV	7	03/08/1994				27			38				* 4440
CC287	RV	7	03/24/1994				27			37				* 4660
CC287	RV	7	04/07/1994				17			35				2440

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC287	RV	7	04/19/1994				7			22				1050
CC287	RV	7	05/04/1994				8.3			28				1200
CC287	RV	7	05/19/1994				7.5			26				1010
CC287	RV	7	06/07/1994				11			29				1570
CC287	RV	7	06/23/1994				13			34				1720
CC287	RV	7	07/25/1994				16			42				2490
CC287	RV	7	08/16/1994				20			46				2940
CC287	RV	7	09/13/1994				20			36				3020
CC287	RV	7	10/16/1994				20			31				3480
CC287	RV	7	11/16/1994				32			40				* 5610
CC287	RV	7	12/13/1994				* 41			39				* 6730
CC287	RV	7	01/10/1995				38			40				* 6370
CC287	RV	7	02/09/1995				19			26				3380
CC287	RV	7	03/08/1995				15			22				2550
CC287	RV	7	03/22/1995				21			34				3640
CC287	RV	7	04/12/1995				15			27				2500
CC287	RV	7	04/25/1995				12			22				2100
CC287	RV	7	05/10/1995				7.8			23				861
CC287	RV	7	05/23/1995				6.9			22				802
CC287	RV	7	06/13/1995				7			27				906
CC287	RV	7	06/27/1995				8.4			26				1260
CC287	RV	7	07/11/1995				11			34				1700
CC287	RV	7	07/25/1995				14			33				1790
CC287	RV	7	08/14/1995				17			36				2580
CC287	RV	7	09/13/1995				20			38				2800
CC287	RV	7	10/18/1995				* 200			48				2930
CC287	RV	7	11/21/1995				11			45				1670
CC287	RV	7	12/27/1995				18			55				2580
CC287	RV	7	01/17/1996				26			* 223				3870
CC287	RV	7	02/29/1996				15			45				2310
CC287	RV	7	03/28/1996				15			53				2220
CC287	RV	7	04/17/1996				9			55				1220
CC287	RV	7	05/08/1996				11			66				1650
CC287	RV	7	06/19/1996				5.8			36				843
CC287	RV	7	07/24/1996				14			66				1550
CC287	RV	7	08/21/1996				23			94				2620
CC287	RV	7	09/26/1996				24			98				2640

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Dissolved Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
CC287	RV	7	10/29/1996				28			* 174				3780
CC287	RV	7	11/27/1996				29			51				* 4530
CC287	RV	7	12/13/1996				* 39			60				* 5430
CC287	RV	7	01/30/1997				25			48				3590
CC287	RV	7	02/21/1997				26			71				4140
CC287	RV	7	03/26/1997				26			63				3870
CC287	RV	7	04/16/1997				24			46				3380
CC287	RV	7	06/24/1997				5.4			32				797
CC287	RV	7	07/23/1997				9.2			66				1260
CC287	RV	7	08/14/1997				14			54				2010
CC287	RV	7	09/04/1997				18			* 114				2390
CC287	RV	7	10/16/1997				20			57				2750
CC287	RV	7	11/26/1997				18			49				2840
CC287	RV	7	12/19/1997				27			43				3340
CC287	RV	7	01/22/1998				26			44				3320
CC287	RV	7	02/26/1998				25			42				3560
CC287	RV	7	03/20/1998				21			45				2780
CC287	RV	7	04/23/1998				11			* 271				1290
CC287	RV	7	05/07/1998				3.9			33				535
CC287	RV	7	05/28/1998				7.3			35				966
CC287	RV	7	05/28/1998				6.8			37				943
CC287	RV	7	06/26/1998				9.9			34				1220
CC287	RV	7	07/28/1998				17			46				1720
CC287	RV	7	08/26/1998				18			42				2110
CC287	RV	7	09/24/1998				17			50				2260
CC287	RV	7	10/01/1998				18			39				2270
CC287	RV	7	10/08/1998				21			45				2700
CC287	RV	7	10/26/1998				19			34				2270
CC287	RV	7	11/25/1998				* 49			54				* 7240
CC287	RV	7	01/15/1999				27			38				3660
CC287	RV	7	02/23/1999				29			28				3770
CC287	RV	7	03/08/1999				28			31				3880
CC287	RV	3	05/14/1998		1.4	2 U	5.2	2 U	28	25.7	33	0.2 U	0.2 U	688
CC288	RV	2	11/09/1997		4.2	0.18	20.2	1.3	18	49.9	68.9	0.2 U	0.03 U	2680
CC288	RV	2	01/13/1998		4.1 J	0.12 U	30.6	0.89 J	24.7	29.9	92.5	0.1 UJ	0.11 U	* 4210
CC288	RV	18	10/26/1998				21			31				2380
CC288	RV	18	10/26/1998				21			32				2570

Data Summary Table
Canyon Creek - segment CCSeg05

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
CC288	RV	18	11/18/1998				31			32				* 4270
CC288	RV	18	12/15/1998				28			29				* 4330
CC288	RV	18	12/28/1998				30			31				* 4440
CC288	RV	18	03/23/1999				26			40				3630
CC288	RV	18	04/19/1999				14			22				1830
CC288	RV	18	05/05/1999				9.2		26	22	81			1290
CC288	RV	18	05/24/1999				5.8		16	26	45			671
CC288	RV	18	05/27/1999				4.8		9	17	36			604
CC288	RV	18	06/02/1999				4.4		18	23	36			571
CC288	RV	18	06/15/1999				3.6			18				451
CC288	RV	18	07/08/1999				5			20				702
CC288	RV	18	08/05/1999				12			31				1480
CC288	RV	18	08/30/1999				15			37				1790
CC288	RV	3	05/14/1998		1.4	2 U	5.4	2 U	26	25.3	33	0.2 U	0.2 U	673
CC288	RV	3	05/17/1998		2.3 U	0.23 U	6.7 J	1.2 J	110 J		43.3 J	0.16 U	0.042 UJ	
CC288	RV	11	11/14/1998		6.1	1 U	34	5 U	50 U	34.6	102	0.2 U	5 U	* 4610
CC356	AD	3	05/15/1998		0.5 U	0.4 J	0.3 J	0.6 J	624 J	1.5 J	18.6 J	0.2 UJ		206 J
CC357	SP	3	05/16/1998		0.5 U	0.5 J	* 51.5 J	4.1 J		41	* 3850 J	0.2 UJ		
CC454	RV	11	11/13/1998		6.3	0.2 U	12 J	0.47 U	6.9 U	16.2	98.4	0.2 U	4.5 U	1600
CC454	RV	23	12/02/1999		3.9 J	1 U	8	5 U	43.2 J	16.7	62.8	0.2 U	5 U	1270
CC455	RV	11	11/13/1998		6.1	0.2 U			6.9 U		92.1	0.2 U	4.5 U	1760
CC455	RV	11	11/13/1998				14.2 J	0.66 U		19.2				
CC455	RV	11	11/14/1998		6.6	1.2 J	18.2	5 U	50 U	31.5	101	0.2 U	5 U	2570
CC455	RV	11	12/07/1998		5.2	0.36 U	20.2	1.2 J	84.8 J	33.3	112	0.2 UJ	4.5 U	2980
CC455	RV	23	12/02/1999		3.9 J	1 U	9.9	5 U	36 J	17.2	60.2	0.2 U	5 U	1570
CC457	RV	11	11/14/1998		6.2	1 U	35.9	5 U	50 U	39.5	116	0.2 U	5 U	* 4760
CC457	RV	23	12/02/1999		3.8 J	1 U	18.7	5 U	25 U	25	75.3	0.2 U	5 U	2720
CC482	RV	11	11/14/1998		6.1	1 U	34.1	5 U	50 U	37	103	0.2 U	5 U	* 4630
CC482	RV	11	12/09/1998		5.5	1 U	35.8	5 U	50 U	37.3	109	0.2 U	5 U	* 5440
CC482	RV	23	12/01/1999		3.9 J	1 U	19.9	5 U	25 U	24.1	62.4	0.2 U	5 U	3030

ATTACHMENT 3
Statistical Summary Tables for Metals

Statistical Summary of Total Metals Concentrations in Surface Water
Segment CCSeg01
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	7	1	4	4	4	< 0.001	2	1	0	0
Copper	7	2	1.7	41	21.4	1.3	1	2	1	0
Iron	6	1	22	22	22	< 0.001	300	0	0	0
Lead	7	3	0.5	6.5	2.6	1.3	15	0	0	0
Manganese	7	2	2	4	3	0.47	50	0	0	0
Zinc	7	3	5.4	32	14.5	1.04	30	1	0	0

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment CCSeg01
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Copper	6	1	1.5	1.5	1.5	< 0.001	3.2	0	0	0
Iron	6	2	4.1	4.2	4.15	0.02	1,000	0	0	0
Lead	2	1	0.58	0.58	0.58	< 0.001	1.09	0	0	0
Manganese	6	3	2	6	3.33	0.69	20.4	0	0	0
Zinc	6	2	5.4	10.1	7.75	0.43	42	0	0	0

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment CCSeg02
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Arsenic	4	3	9.1	11.1	9.93	0.1	22	0	0	0
Cadmium	13	13	0.276	16.7	3.46	1.37	9.8	1	0	0
Copper	4	4	23.2	73.1	52	0.4	100	0	0	0
Iron	12	12	2,660	238,000	42,400	1.64	65,000	2	0	0
Lead	8	8	6.49	2,550	776	1.1	171	5	1	0
Manganese	4	4	681	1,310	1,050	0.26	3,597	0	0	0
Zinc	13	13	5.09	1,620	378	1.31	280	5	0	0

Statistical Summary of Total Metals Concentrations in Subsurface Soil
Segment CCSeg02
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	3	1	38.6	38.6	38.6	< 0.001	31.3	1	0	0
Arsenic	3	3	13.2	32.9	23.5	0.42	22	2	0	0
Cadmium	3	2	1.2	12.5	6.85	1.17	9.8	1	0	0
Copper	3	3	14.4	97.9	44	1.06	100	0	0	0
Iron	3	3	10,000	16,200	14,000	0.25	65,000	0	0	0
Lead	3	3	23.6	12,400	4,170	1.71	171	1	1	0
Manganese	3	3	101	980	538	0.82	3,597	0	0	0
Mercury	3	1	2.1	2.1	2.1	< 0.001	23.5	0	0	0
Silver	3	1	24.4	24.4	24.4	< 0.001	391	0	0	0
Zinc	3	3	59.3	3.220	1,260	1.36	280	2	1	0

Statistical Summary of Total Metals Concentrations in Sediment
Segment CCSeg02
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	2	2	1.1	1.7	1.4	0.3	3.3	0	0	0
Arsenic	2	2	3.6	4.5	4.05	0.16	13.6	0	0	0
Cadmium	3	3	0.52	2.85	1.34	0.98	1.56	1	0	0
Copper	2	2	25.5	32.5	29	0.17	32.3	1	0	0
Iron	3	3	11,600	12,000	11,800	0.02	40,000	0	0	0
Lead	3	3	88	304	184	0.6	51.5	3	0	0
Manganese	2	2	428	665	547	0.31	1,210	0	0	0
Mercury	2	1	0.13	0.13	0.13	< 0.001	0.179	0	0	0
Silver	2	2	0.57	347	174	1.41	4.5	1	1	0
Zinc	3	3	162	257	213	0.22	200	2	0	0

Statistical Summary of Total Metals Concentrations in Groundwater
Segment CCSeg02
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	2	1	1.6	1.6	1.6	< 0.001	6	0	0	0
Arsenic	2	2	2.2	4.5	3.35	0.49	50	0	0	0
Cadmium	2	1	3	3	3	< 0.001	2	1	0	0
Copper	2	1	0.51	0.51	0.51	< 0.001	1	0	0	0
Lead	2	1	0.44	0.44	0.44	< 0.001	15	0	0	0
Zinc	2	1	610	610	610	< 0.001	30	1	1	0

Statistical Summary of Dissolved Metals Concentrations in Groundwater
Segment CCSeg02
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	2	1	0.93	0.93	0.93	< 0.001	2.92	0	0	0
Arsenic	2	2	2	4.2	3.1	0.5	150	0	0	0
Cadmium	2	1	2.9	2.9	2.9	< 0.001	0.38	1	0	0
Lead	2	1	0.13	0.13	0.13	< 0.001	1.09	0	0	0
Zinc	2	1	510	510	510	< 0.001	42	1	1	0

Statistical Summary of Total Metals Concentrations in Surface Water
Segment CCSeg02
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	54	6	0.1	1.2	0.683	0.57	2	0	0	0
Copper	6	1	0.96	0.96	0.96	< 0.001	1	0	0	0
Iron	7	3	6.7	60	41.6	0.73	300	0	0	0
Lead	55	29	0.24	11	3.3	0.92	15	0	0	0
Manganese	7	2	2	8	5	0.85	50	0	0	0
Zinc	55	51	4.6	200	28.3	1.28	30	11	0	0

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment CCSeg02
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	56	7	0.043	1.3	0.52	0.94	0.38	4	0	0
Lead	56	11	0.12	3	1.92	0.63	1.09	7	0	0
Zinc	56	48	3	52	21.2	0.51	42	1	0	0

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment CCSeg03
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	12	12	0.0799	42.9	6.47	1.93	9.8	2	0	0
Copper	4	4	5.65	334	134	1.11	100	2	0	0
Iron	12	12	2,490	159,000	48,800	1.06	65,000	2	0	0
Lead	11	11	36.1	15,000	3,540	1.51	171	7	4	0
Zinc	11	11	10.1	8,780	1,090	2.39	280	3	1	0

Statistical Summary of Total Metals Concentrations in Groundwater
Segment CCSeg03
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	2	2	12.1	18	15.1	0.28	6	2	0	0
Arsenic	2	1	0.28	0.28	0.28	< 0.001	50	0	0	0
Cadmium	2	1	0.34	0.34	0.34	< 0.001	2	0	0	0
Iron	2	1	97.7	97.7	97.7	< 0.001	300	0	0	0
Lead	2	2	9.8	27.1	18.5	0.66	15	1	0	0
Manganese	2	2	7.5	10.5	9	0.24	50	0	0	0
Mercury	2	1	0.33	0.33	0.33	< 0.001	2	0	0	0
Zinc	2	2	32.8	35.7	34.3	0.06	30	2	0	0

Statistical Summary of Dissolved Metals Concentrations in Groundwater
Segment CCSeg03
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	2	2	11.3	18.2	14.8	0.33	2.92	2	0	0
Arsenic	2	1	0.43	0.43	0.43	< 0.001	150	0	0	0
Cadmium	2	1	0.39	0.39	0.39	< 0.001	0.38	1	0	0
Lead	2	2	2.6	9.2	5.9	0.79	1.09	2	0	0
Manganese	2	1	2.3	2.3	2.3	< 0.001	20.4	0	0	0
Mercury	2	1	0.49	0.49	0.49	< 0.001	0.77	0	0	0
Zinc	2	2	28.4	33.2	30.8	0.11	42	0	0	0

Statistical Summary of Total Metals Concentrations in Surface Water
Segment CCSeg03
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	3	3	5.2	85.1	43	0.93	6	2	1	0
Arsenic	3	3	1.1	2	1.53	0.29	50	0	0	0
Cadmium	6	5	1.4	2	1.66	0.16	2	0	0	0
Iron	4	1	260	260	260	< 0.001	300	0	0	0
Lead	5	5	19	232	66	1.41	15	5	1	0
Manganese	4	2	81.1	150	116	0.42	50	2	0	0
Zinc	6	6	98	210	156	0.25	30	6	0	0

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment CCSeg03
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	3	3	5.2	81.5	41.6	0.92	2.92	3	2	0
Arsenic	3	1	1.2	1.2	1.2	< 0.001	150	0	0	0
Cadmium	6	5	0.3	1.9	1.38	0.47	0.38	4	0	0
Copper	4	1	10	10	10	< 0.001	3.2	1	0	0
Iron	4	1	250	250	250	< 0.001	1,000	0	0	0
Lead	5	4	4	26.9	14.9	0.64	1.09	4	3	0
Manganese	4	2	76.9	140	108	0.41	20.4	2	0	0
Zinc	6	5	54	180	133	0.38	42	5	0	0

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment CCSeg04
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	11	11	1.7	242	47.1	1.48	31.3	5	0	0
Arsenic	12	12	5.8	3,610	350	2.94	22	9	1	1
Cadmium	79	78	0.0147	172	13	2.08	9.8	24	2	0
Copper	32	32	16.3	1,220	310	1.07	100	20	2	0
Iron	85	85	2,270	547,000	57,100	1.56	65,000	19	0	0
Lead	75	75	1.78	74,500	7,010	1.95	171	62	32	11
Manganese	12	12	503	8,460	2,510	0.86	3,597	1	0	0
Mercury	12	12	0.11	6	2.12	1.08	23.5	0	0	0
Silver	12	11	0.45	157	46.7	1.28	391	0	0	0
Zinc	77	77	1.4	110,000	5,370	2.76	280	48	17	3

Statistical Summary of Total Metals Concentrations in Subsurface Soil
Segment CCSeg04
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	32	10	1.3	764	106	2.29	31.3	2	1	0
Arsenic	32	32	0.91	87.2	11.5	1.54	22	5	0	0
Cadmium	32	17	0.48	441	39.2	2.88	9.8	2	2	0
Copper	32	32	3.9	370	38.4	2.08	100	2	0	0
Iron	32	32	7,690	50,700	14,900	0.63	65,000	0	0	0
Lead	32	32	11.8	59,300	3,570	3.59	171	10	3	2
Manganese	32	32	234	10,100	1,080	1.65	3,597	1	0	0
Mercury	32	8	0.07	13.7	4	1.49	23.5	0	0	0
Silver	32	3	7.5	126	85.5	0.79	391	0	0	0
Zinc	32	32	16.8	55,400	2,890	3.77	280	12	2	2

Statistical Summary of Total Metals Concentrations in Sediment
Segment CCSeg04
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	3	2	51.8	85.7	68.8	0.35	3.3	2	2	0
Arsenic	3	3	4.5	29.1	17.6	0.7	13.6	2	0	0
Cadmium	7	7	8.2	133	39.1	1.11	1.56	7	5	0
Copper	4	4	19.6	185	113	0.63	32.3	3	0	0
Iron	7	7	8,090	77,700	39,300	0.53	40,000	3	0	0
Lead	7	7	858	23,900	7,200	1.08	51.5	7	7	3
Manganese	3	3	330	2,910	1,700	0.76	1,210	2	0	0
Mercury	3	3	0.68	5	3.49	0.7	0.179	3	2	0
Silver	3	3	1.6	43.1	22.6	0.92	4.5	2	0	0
Zinc	7	7	1,480	22,900	6,210	1.26	200	7	6	1

Statistical Summary of Total Metals Concentrations in Groundwater
Segment CCSeg04
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	50	21	1.4	10.5	5.41	0.49	6	10	0	0
Arsenic	50	8	0.26	3.9	2.28	0.55	50	0	0	0
Cadmium	50	38	0.1	209	25.7	1.97	2	27	10	2
Copper	50	17	0.46	21.3	5.56	1.26	1	11	4	0
Iron	50	19	11.4	5,110	943	1.71	300	8	2	0
Lead	50	40	0.46	698	69.4	2.44	15	15	5	0
Manganese	50	15	2.4	3,300	305	2.79	50	5	2	0
Zinc	50	47	2.8	33,800	3,300	2.3	30	37	25	11

Statistical Summary of Dissolved Metals Concentrations in Groundwater
Segment CCSeg04
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	50	21	1.4	8.7	5.26	0.44	2.92	16	0	0
Arsenic	50	8	0.23	4.1	2.13	0.74	150	0	0	0
Cadmium	50	34	0.44	212	28.6	1.86	0.38	34	24	5
Copper	50	11	0.3	22.8	6.66	1.28	3.2	4	0	0
Iron	50	6	14.1	177	120	0.55	1,000	0	0	0
Lead	50	28	0.33	692	93.8	2.07	1.09	24	14	5
Manganese	50	12	2.5	98	28.3	1.37	20.4	3	0	0
Zinc	50	44	1.4	33,400	3,460	2.23	42	33	24	8

Statistical Summary of Total Metals Concentrations in Surface Water
Segment CCSeg04
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	62	57	0.6	10.4	4.52	0.56	6	17	0	0
Arsenic	62	32	0.32	3.4	1.1	0.68	50	0	0	0
Cadmium	244	235	0.25	66	4.58	1.2	2	164	2	0
Copper	64	22	0.21	1,020	49.2	4.41	1	11	2	1
Iron	62	55	6.8	5,970	430	1.94	300	17	1	0
Lead	244	240	1.6	1,700	60.4	3.25	15	141	15	2
Manganese	65	59	10	39,000	866	5.89	50	26	6	2
Mercury	64	4	0.15	0.29	0.21	0.28	2	0	0	0
Silver	64	1	0.71	0.71	0.71	< 0.001	100	0	0	0
Zinc	244	243	30.3	16,000	815	2.04	30	243	161	4

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment CCSeg04
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	61	59	0.6	7.3	3.96	0.52	2.92	40	0	0
Arsenic	61	30	0.14	2.8	0.634	1.04	150	0	0	0
Cadmium	240	235	0.25	64.3	4.32	1.23	0.38	232	104	1
Copper	61	13	0.1	0.95	0.534	0.49	3.2	0	0	0
Iron	62	37	19	4,810	216	3.63	1,000	1	0	0
Lead	240	224	0.13	308	13.8	1.78	1.09	221	91	3
Manganese	62	56	6.2	5,160	183	3.94	20.4	48	5	1
Silver	61	1	0.6	0.6	0.6	< 0.001	0.43	1	0	0
Zinc	240	239	7.08	17,300	809	2.14	42	231	132	4

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment CCSeg05
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	13	10	0.67	70.3	17.7	1.21	31.3	2	0	0
Arsenic	23	23	2.2	215	34.2	1.26	22	11	0	0
Cadmium	45	42	0.231	148	16.3	1.48	9.8	21	1	0
Copper	31	31	26.5	412	113	0.78	100	16	0	0
Iron	45	45	5,750	58,000	25,800	0.45	65,000	0	0	0
Lead	44	44	62.3	42,200	6,260	1.49	171	36	27	4
Manganese	23	23	195	4,920	1,600	0.84	3,597	4	0	0
Mercury	17	10	0.17	15.5	4.05	1.08	23.5	0	0	0
Silver	17	15	0.46	82.3	14.4	1.49	391	0	0	0
Zinc	45	45	0.691	24,300	2,140	1.83	280	35	10	0

Statistical Summary of Total Metals Concentrations in Subsurface Soil
Segment CCSeg05
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	38	29	0.6	33.1	14.2	0.76	31.3	1	0	0
Arsenic	48	48	1.4	49.1	15	0.87	22	11	0	0
Cadmium	47	38	0.71	64.1	12	1.19	9.8	15	0	0
Copper	48	48	3.5	329	79.8	1.13	100	14	0	0
Iron	47	47	1,980	51,900	21,000	0.64	65,000	0	0	0
Lead	47	47	7.5	8,460	2,060	1.26	171	26	17	0
Manganese	47	47	38.8	2,990	1,010	0.8	3,597	0	0	0
Mercury	48	29	0.15	5	1.64	0.94	23.5	0	0	0
Silver	48	28	0.22	29.9	11.4	0.78	391	0	0	0
Zinc	47	47	34.9	7,110	1,320	1.23	280	30	6	0

Statistical Summary of Total Metals Concentrations in Sediment
Segment CCSeg05
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	9	7	1	288	81.1	1.42	3.3	5	2	0
Arsenic	9	9	3.6	90.7	20.4	1.33	13.6	4	0	0
Cadmium	9	9	5.1	132	26.2	1.63	1.56	9	2	0
Copper	9	9	19.1	1,500	271	1.79	32.3	6	2	0
Iron	9	9	7,760	67,800	25,000	0.72	40,000	1	0	0
Lead	9	9	37.4	67,100	11,300	1.88	51.5	8	8	3
Manganese	9	9	538	2,280	1,220	0.51	1,210	3	0	0
Mercury	9	9	0.07	24	3.62	2.14	0.179	7	3	1
Silver	9	9	0.42	105	26.9	1.6	4.5	6	2	0
Zinc	9	9	703	22,400	4,310	1.68	200	9	2	1

Statistical Summary of Total Metals Concentrations in Groundwater
Segment CCSeg05
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	56	17	1	12.5	3.04	0.92	6	1	0	0
Arsenic	88	28	0.21	250	36.3	1.72	50	7	0	0
Cadmium	88	85	0.2	2,551	211	1.59	2	84	75	25
Copper	56	23	0.9	44.6	19.4	0.65	1	22	16	0
Iron	56	15	7.1	2,420	433	1.51	300	5	0	0
Lead	88	85	0.62	54,894	3,390	2.74	15	57	39	24
Manganese	56	36	1.8	8,030	651	2.73	50	13	10	2
Silver	56	1	4.6	4.6	4.6	< 0.001	100	0	0	0
Zinc	88	87	17.4	105,740	24,700	1	30	86	84	74

Statistical Summary of Dissolved Metals Concentrations in Groundwater
Segment CCSeg05
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	56	16	1.5	12.1	3.27	0.82	2.92	4	0	0
Arsenic	116	15	0.32	14	3.02	1.51	150	0	0	0
Cadmium	185	181	0.15	1,047	186	0.97	0.38	180	179	158
Copper	68	34	0.91	127	26.3	0.94	3.2	31	9	0
Iron	56	11	8.5	2,250	401	1.66	1,000	1	0	0
Lead	185	174	2	13,836	906	1.67	1.09	174	153	117
Manganese	56	34	3.6	7,510	663	2.58	20.4	15	11	2
Mercury	65	1	0.39	0.39	0.39	< 0.001	0.77	0	0	0
Silver	56	3	4.7	527	184	1.61	0.43	3	3	1
Zinc	185	184	16.1	172,400	26,000	1.05	42	182	180	158

Statistical Summary of Total Metals Concentrations in Surface Water
Segment CCSeg05
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	38	33	1.4	11.5	5.13	0.49	6	9	0	0
Arsenic	38	9	0.23	2.2	0.884	0.84	50	0	0	0
Cadmium	346	327	0.3	407	14.4	2.21	2	320	57	2
Copper	39	19	0.8	14.8	3.98	1	1	18	3	0
Iron	41	38	56.6	5,400	521	2	300	12	2	0
Lead	295	294	0.082	2,920	161	2.32	15	288	46	8
Manganese	44	44	8.11	3,170	172	2.74	50	35	2	0
Mercury	39	4	0.17	0.58	0.315	0.59	2	0	0	0
Silver	38	1	0.61	0.61	0.61	< 0.001	100	0	0	0
Zinc	347	347	156	35,400	1,730	1.32	30	347	336	50

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment CCSeg05
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	35	32	1.3	6.6	4.21	0.38	2.92	26	0	0
Arsenic	35	10	0.18	1.4	0.478	0.94	150	0	0	0
Cadmium	237	237	0.3	408	18.2	2.1	0.38	236	221	7
Copper	36	16	0.6	4.1	1.26	0.62	3.2	1	0	0
Iron	41	31	9	624	71.7	2.04	1,000	0	0	0
Lead	236	235	1.5	1,480	45.2	2.32	1.09	235	225	7
Manganese	41	41	0.41	3,850	160	3.69	20.4	39	1	1
Zinc	237	237	151	9,370	2,110	0.68	42	237	230	21

ATTACHMENT 4
Screening Levels

SCREENING LEVELS

Based on the results of the human health and ecological risk assessments, 10 chemicals of potential concern (COPCs) were identified for inclusion and evaluation in the RI. The COPCs and appropriate corresponding media (soil, sediment, groundwater, and surface water) are summarized in Table 1. For each of the COPCs listed in Table 1, a screening level was selected.

The screening levels were used in the RI to help identify source areas and media of concern that would be carried forward for evaluation in the feasibility study (FS). The following paragraphs discuss the rationale for the selection of the screening levels.

Applicable risk-based screening levels and background concentrations were compiled from available federal numeric criteria (e.g., National Ambient Water Quality Criteria), regional preliminary remediation goals (PRGs) (e.g., EPA Region IX PRGs), regional background studies for soil, sediment, and surface water, and other guidance documents (e.g., National Oceanographic and Atmospheric Administration freshwater sediment screening values). Selected RI screening levels are listed in Tables 2 through 4.

For the evaluation of site soil, sediment, groundwater, and surface water chemical data, the lowest available risk-based screening level for each media was selected as the screening level. If the lowest risk-based screening level was lower than the available background concentration, the background concentration was selected as the screening level.

Groundwater data are screened against surface water screening levels to evaluate the potential for impacts to surface water from groundwater discharge.

For site groundwater and surface water, total and dissolved metals data are evaluated separately. Risk-based screening levels for protection of human health (consumption of water) are based on total metals results, therefore, total metals data for site groundwater and surface water were evaluated against screening levels selected from human health risk-based screening levels. Risk-based screening levels for protection of aquatic life are based on dissolved metals results, therefore, dissolved metals data for site groundwater and surface water were evaluated against screening levels selected from aquatic life risk-based screening levels.

Table 1
Chemicals of Potential Concern

	Human Health COPC			Ecological COPC		
Chemical	**Soil/Sediment**	**Groundwater**	**Surface Water**	**Soil**	**Sediment**	**Surface Water**
Antimony	X	X				
Arsenic	X	X	X	X	X	
Cadmium	X	X	X	X	X	X
Copper				X	X	X
Iron	X					
Lead	X	X	X	X	X	X
Manganese	X		X			
Mercury			X		X	
Silver					X	
Zinc	X	X	X	X	X	X

Table 2
Selected Screening Levels for Groundwater and Surface Water—Coeur d'Alene River Basin and Coeur d'Alene Lake

Chemical	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Groundwater Total (µg/L)	Groundwater Dissolved (µg/L)
Antimony	6[a]	2.92[b]	6[a]	2.92[b]
Arsenic	50[a]	150[c,d]	50[a]	150[c,d]
Cadmium	2[e,f]	0.38[b]	2[e,f]	0.38[b]
Copper	1[e,f]	3.2[c,d]	1[e,f]	3.2[c,d]
Iron	300[a]	1,000[c,d]	300[a]	1,000[c,d]
Lead	15[a]	1.09[b]	15[a]	1.09[b]
Manganese	50[a]	20.4[b]	50[a]	20.4[b]
Mercury	2[a]	0.77[c,d]	2[a]	0.77[c,d]
Silver	100[a]	0.43[c,d]	100[a]	0.43[c,d]
Zinc	30[e,f]	42[c,d]	30[e,f]	42[c,d]

[a]40 CFR 141 and 143. National Primary and Secondary Drinking Water Regulations. U.S. EPA Office of Water. Office of Groundwater and Drinking Water. http://www.epa.gov/OGWDW/wot/appa.html. October 18, 1999.
[b]Dissolved surface water 95th percentile background concentrations calculated from URS project database.
[c]Freshwater NAWQC for protection of aquatic life are expressed in terms of the dissolved metal in the water column.
[d]Freshwater NAWQC for cadmium, copper, lead, silver, and zinc are expressed as a function of hardness (mg/L of CaCO3) in the water column.
Values above correspond to a hardness value of 30 mg/L.
[e]Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of Energy. Office of Environmental Management. ES/ER/TM-96/R2. Value based on total metals concentration.
[f]Value based on the protection of aquatic plants.

Note:
µg/L - microgram per liter

Table 3
Selected Screening Levels for Surface Water—Spokane River Basin

Chemical	SpokaneRSeg01		SpokaneRSeg02		SpokaneRSeg03	
	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)
Antimony	6[a]	2.92[b]	6[a]	2.92[b]	6[a]	2.92[b]
Arsenic	50[a]	150[c]	50[a]	150[c]	50[a]	150[c]
Cadmium	2[e,f]	0.38[b]	2[e,f]	0.38[b]	2[e,f]	0.38[b]
Copper	1[e,f]	2.3[c,d]	1[e,f]	3.8[c,d]	1[e,f]	5.7[c,d]
Iron	300[a]	1,000[c]	300[a]	1,000[c]	300[a]	1,000[c]
Lead	15[a]	1.09[b]	15[a]	1.09[b]	15[a]	1.4[c,d]
Manganese	50[a]	20.4[b]	50[a]	20.4[b]	50[a]	20.4[b]
Mercury	2[a]	0.77[c]	2[a]	0.77[c]	2[a]	0.77[c]
Silver	100[a]	0.22[c,d]	100[a]	0.62[c,d]	100[a]	1.4[c,d]
Zinc	30[e,f]	30[c,d]	30[e,f]	50[c,d]	30[e,f]	75[c,d]

[a]40 CFR 141 and 143. National Primary and Secondary Drinking Water Regulations. U.S. EPA Office of Water. Office of Groundwater and Drinking Water. http://www.epa.gov/OGWDW/wot/appa.html. October 18, 1999.
[b]Dissolved surface water 95th percentile background concentrations calculated from URS project database. Technical Memorandum. Estimation of Background Concentration in Soils, Sediments, and Surface Waters. Coeur d'Alene Basin RI/FS. URS. May 2001.
[c]Freshwater NAWQC for protection of aquatic life are expressed in terms of the dissolved metal in the water column.
[d]Freshwater NAWQC for cadmium, copper, lead, silver, and zinc are expressed as a function of hardness (mg/L of CaCO3) in the water column for segments 01, 02, and 03 of 20, 37, and 59 mg/L, respectively).
[e]Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of Energy. Office of Environmental Management. ES/ER/TM-96/R2. Value based on total metals concentration.
[f]Value based on the protection of aquatic plants.

Note:
µg/L - microgram per liter

Table 4
Selected Screening Levels—Soil and Sediment

Chemical	Upper Coeur d'Alene River Basin		Lower Coeur d'Alene River Basin		Spokane River Basin	
	Soil (mg/kg)	Sediment (mg/kg)	Soil (mg/kg)	Sediment (mg/kg)	Soil (mg/kg)	Sediment (mg/kg)
Antimony	31.3[a]	3.30[b]	31.3[a]	3[c]	31.3[a]	3[c]
Arsenic	22[b]	13.6[b]	12.6[b]	12.6[b]	9.34[b]	9.34[b]
Cadmium	9.8[d]	1.56[b]	9.8[d]	0.678[b]	9.8[d]	0.72[b]
Copper	100[d]	32.3[b]	100[d]	28[c]	100[d]	28[c]
Iron	65,000[b]	40,000[c]	27,600[b]	40,000[c]	25,000[b]	40,000[c]
Lead	171[b]	51.5[b]	47.3[b]	47.3[b]	14.9[b]	14.9[b]
Manganese	3,597[b]	1,210[b]	1,760[a]	630[c]	1,760[a]	663[b]
Mercury	23.5[a]	0.179[b]	23.5[a]	0.179[b]	23.5[a]	0.174[c]
Silver	391[a]	4.5[c]	391[a]	4.5[c]	391[a]	4.5[c]
Zinc	280[b]	200[b]	97.1[b]	97.1[b]	66.4[b]	66.4[b]

[a]U.S. EPA Region IX Preliminary Remediation Goals for Residential or Industrial Soil http://www.epa.gov/region09/wasate/sfund/prg. February 3, 2000.

[b]Technical Memorandum. Estimation of Background Concentration in Soils, Sediments, and Surface Waters. Coeur d'Alene Basin RI/FS. URS. May 2001.

[c]Values as presented in National Oceanographic and Atmospheric Administration Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA. M. F. Buchman, 1999. Values generated from numerous reference documents.

[d]Final Ecological Risk Assessment. Coeur d'Alene Basin RI/FS. Prepared by CH2M HILL/URS for EPA Region 10. May 18, 2001. Values are the lowest of the NOAEL-based PRGs for terrestrial biota (Table ES-3).

Note:
mg/kg - milligrams per kilogram

CSM Unit 1, Upper Watersheds

Beaver Creek

CONTENTS

CONTENTS (Continued)

ATTACHMENTS

FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

AWQC	ambient water quality criteria
BLM	Bureau of Land Management
BvrCrkSeg	Beaver Creek segment
cfs	cubic foot per second
COPC	chemical of potential concern
CSM	conceptual site model
EPA	U.S. Environmental Protection Agency
FIS	flood insurance study
FS	feasibility study
μg/L	microgram per liter
msl	mean sea level
North Fork	North Fork Coeur d'Alene River
PRG	preliminary remediation goal
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
SL	screening level
South Fork	South Fork Coeur d'Alene River
TMDL	total maximum daily load
URSG	URS Greiner, Inc.
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

1.0 INTRODUCTION

The Beaver Creek Watershed is located within the Coeur d'Alene River basin and is a northwest-flowing tributary of the North Fork Coeur d'Alene River (North Fork). The Bureau of Land Management (BLM) has identified 74 source areas (e.g., mining waste rock dumps, adits, and jig tailings piles) within the watershed (BLM 1999). The watershed has been affected by mining activities and past and continuing releases of metals from mining wastes.

Previous clean-up action in the Beaver Creek watershed consists of some isolated portal closures conducted by the USDA Forest Service in the 1998, 1999, and 2000 field seasons. This watershed is included in an integrated watershed analysis of the Prichard, Beaver, and Eagle Creek drainages that is currently being performed for the Forest Service and Bureau of Land Management by the United States Geological Survey. The watershed analysis is being used to help assess the environmental and human health risks and to establish priorities for reclamation work at numerous abandoned mine sites located in the National Forest lands in these watersheds (Johnson 2000).

This watershed is one of eight watersheds assigned to conceptual site model (CSM) Unit 1, Upper Watersheds (see Part 1, Section 2, Conceptual Site Model Summary). The watershed itself is entirely within one segment (Figure 1.1-1). A brief description of the Beaver Creek Watershed is presented in this section.

1.1 SEGMENT DESCRIPTION

This segment contains the headwaters of Beaver Creek to its confluence with the North Fork (Figure 4.1-1). Mining and milling were done in the upper portion of the Beaver Creek Watershed. Sampling of surface water from below the Carlisle Mill site indicates that metals concentrations are greater than ambient water quality criteria (AWQC). Metals concentrations decrease from this point on in the lower portion of the watershed. Fish populations in the watershed appear to be low but are generally comparable to those observed in reference streams, as discussed in the ecological risk assessment.

1.2 REPORT ORGANIZATION

The remedial investigation report is divided into seven parts. This report on the Beaver Creek Watershed is one of eight reports contained within Part 2 presenting the remedial investigation (RI) results for the eight CSM Unit 1 upper watersheds. The content and organization of this report are based on the U.S. Environmental Protection Agency's (EPA's) *Guidance Document for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final* (USEPA 1988). This report contains the following sections:

- Section 2–Physical Setting, includes discussions on the watershed's geology, hydrogeology, and surface water hydrology.
- Section 3–Sediment Transport Processes
- Section 4–Nature and Extent of Contamination, includes a summary of chemical results and estimates of mass loading from source areas
- Section 5–Fate and Transport, includes chemical and physical transport processes for metals
- Section 6–References

Risk evaluations and potential remedial actions associated with source and depositional areas are described in the human health risk assessment, the ecological risk assessment, and the feasibility study (all under separate cover).

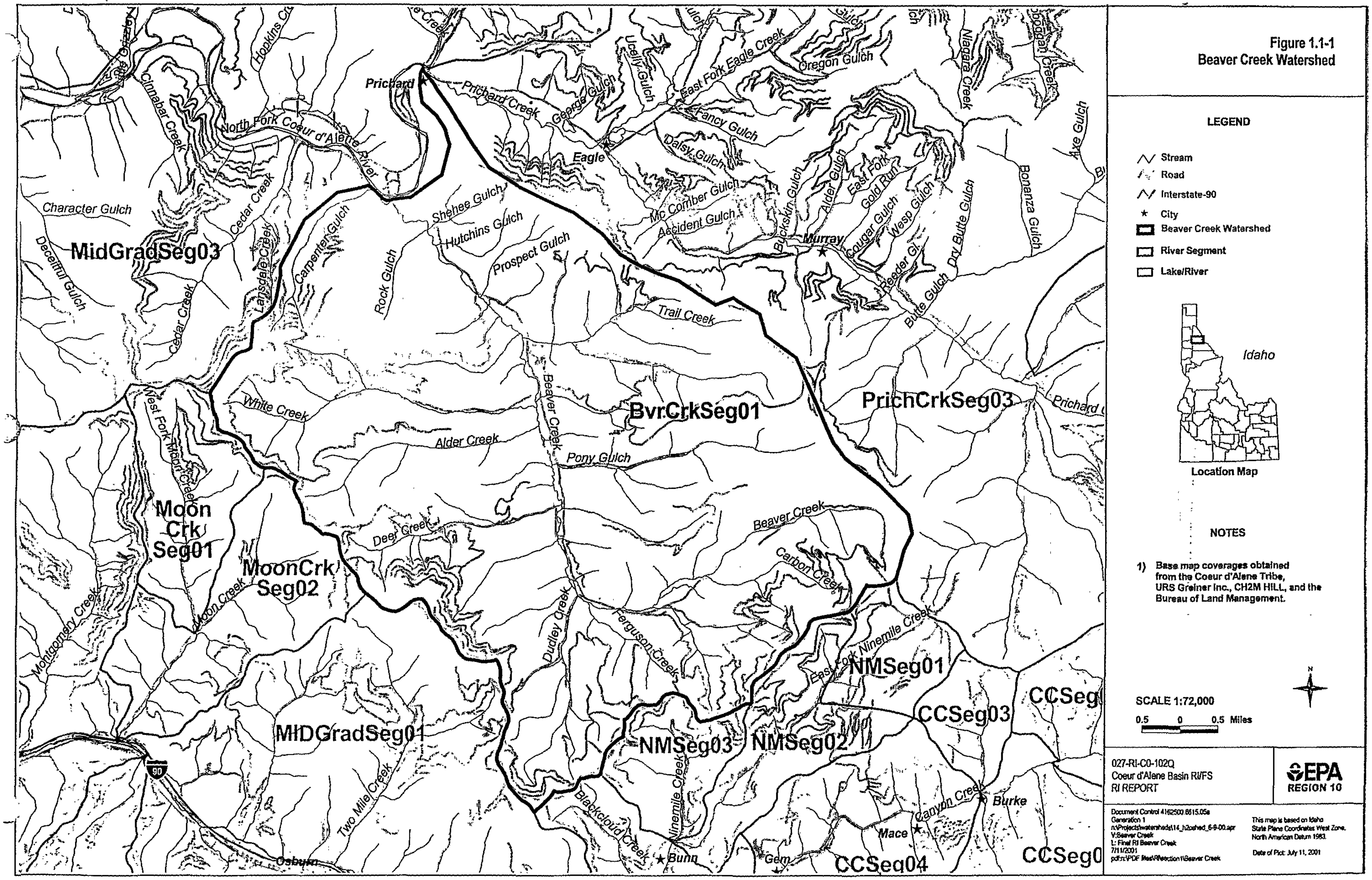


Figure 1.1-1
Beaver Creek Watershed
LEGEND
Stream
Road
Interstate-90
City
Beaver Creek Watershed
River Segment
Lake/River
Idaho
Location Map
NOTES
1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.
SCALE 1:72,000
0.5 0 0.5 Miles
027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT
EPA
REGION 10
Generation 1
V:Beaver Creek
L: Final RI Beaver Creek
7/11/2001
This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.
Date of Plot: July 11, 2001
Prichard
Eagle
Murray
Burke
Mace
Gem
Bunn
Osburn
MidGradSeg03
BvrCrkSeg01
PrichCrkSeg03
Moon Crk Seg01
MoonCrk Seg02
MIDGradSeg01
NMSeg01
NMSeg02
NMSeg03
CCSeg03
CCSeg04
North Fork Coeur d'Alene River
Prichard Creek
Beaver Creek
Cinnabar Creek
Character Gulch
Deceitful Gulch
Cedar Creek
Lansdale Creek
Carpenter Gulch
Rock Gulch
Shehee Gulch
Hutchins Gulch
Prospect Gulch
George Gulch
Ucellt Gulch
East Fork Eagle Creek
Oregon Gulch
Niagara Creek
Fancy Gulch
Daisy Gulch
Mc Comber Gulch
Accident Gulch
Buckskin Gulch
Alder Gulch
East Fork
Gold Run
Cougar Gulch
Wesp Gulch
Reeder Gl.
Dry Butte Gulch
Butte Gulch
Bonanza Gulch
Axe Gulch
Trail Creek
White Creek
Alder Creek
Pony Gulch
Deer Creek
Carbon Creek
Dudley Creek
Ferguson Creek
East Fork Ninemile Creek
Ninemile Creek
Blackcloud Creek
Canyon Creek
Two Mile Creek
Montgomery Creek
Moon Creek
West Fork Moon Creek
Hopkins Creek
90

2.0 PHYSICAL SETTING

2.1 GEOLOGY AND MINES

The geology and mining history of the Beaver Creek Watershed are presented in this section.

2.1.1 Geomorphic Setting

The Beaver Creek Watershed is located 5 to 10 miles north of Wallace between the North Fork and the South Fork Coeur d'Alene River (South Fork) (Part 1, Figure 1.2-2). Beaver Creek and Prichard Creek to the east are the two principal drainages in the district that discharge into the North Fork. The headwaters of Beaver Creek, the principal drainage of the Beaver Creek Watershed, begin at an elevation of approximately 6,000 feet along the north flank of Sunset Peak, which is coincidentally situated at the headwaters of East Fork Ninemile Creek. Beaver Creek flows in a westerly direction for 3 miles and then drains north for approximately 6 miles to the confluence with the North Fork at an elevation of 2,400 feet.

Like most creeks in the district, Beaver Creek flows through a very narrow canyon near the headwaters (Part 1, Figure 3.2-2). The channel widens downstream near the confluence with the North Fork. The floodplain in that area is relatively flat, ranging from 0.1 to 0.3 mile wide and enclosed by steep canyon walls.

2.1.2 Bedrock Geology

Weakly metamorphosed sedimentary rocks assigned to the Precambrian Belt Supergroup are the most prevalent rocks within the Beaver Creek Watershed (Part 1, Figure 3.2-2). Specifically, the Prichard and Wallace Formations are the most prevalent formations in the watershed. The Prichard Formation is present in the upper reaches of Beaver Creek, where the creek flows in a westerly direction. The Prichard commonly consists of argillite in this area, and most of the mines of the watershed are located in the Prichard in the upper reaches of Beaver Creek. The Burke Formation (mainly a quartzite) is the most prevalent formation throughout most of the northerly flowing reach of Beaver Creek to a point approximately 2 miles above the confluence with the North Fork (Umpleby and Jones 1923). At this location, the Revett Formation quartzite is present in the area surrounding the 2-mile reach to the North Fork.

Waste rock piles are present at mine workings in the Beaver Creek Watershed. Waste rock consists of broken, angular rock that is generally unmilled and typically dumped near the mouth of workings. The chemical content of waste rock in the Beaver Creek Watershed is discussed further in Section 4, Nature and Extent of Contamination.

2.1.3 Structural Geology

North-northwest-trending faults dominate the structural fabric of the watershed. The Dobson Pass Fault is the principal structure in the watershed. It is a normal fault which trends north-northwest with (primarily) Prichard Formation argillite on the east side (footwall) of the fault and Wallace Formation argillite on the west side (hanging wall) (Part 1, Figure 3.2-2). The Dobson Pass Fault has been offset by a series of younger east-west faults in the vicinity of Pony Gulch, approximately 2 miles north of the confluence of Dudley Creek and Beaver Creek (Part 1, Figure 3.2-2). The Blue Sky Mine and associated mineralized vein occurs along the Dobson Pass Fault about 1 mile north of Dobson Pass (Part 1, Figure 3.2-2).

The Carlisle Mine is located along the north-northwest-trending normal fault (the Carlisle Fault), which parallels the Dobson Pass Fault about 1.5 miles to the west (Part 1, Figure 3.2-2). The Red Monarch Mine (not shown) is also located along the Carlisle Fault, about 1 mile south of the Carlisle Mine (Part 1, Figures 3.2-2 and 3.2-3). Although not specifically mapped, the Pony Mine appears to be in Pony Gulch along the northern extension of the Carlisle Fault. The Pony Mine (not shown) is located about 2 miles due north of the Carlisle Mine (Part 1, Figure 3.2-3).

Located 1 mile east of the Carlisle Fault is the north-northwest-trending Puritan Fault, which parallels the Carlisle Fault and hosts the lead-zinc-silver vein of the Idora Mine (Part 1, Figures 3.2-1 and 3.2-3).

In addition to north-northwest-trending faulting, folding of the Belt Supergroup rocks occurs along north-northwest-trending folds (Hobbs et al. 1965). A series of subparallel anticlinal and synclinal fold axes occur east of the Dobson Pass Fault (Hobbs et al. 1965).

2.1.4 Soils

Like most of the soils throughout the district, the soils of the Beaver Creek Watershed can be grouped into two broad categories: hillside soils and valley soils. Hillside soils typically consist of silty loam with variable amounts of gravels and clay, generally less than 2 feet thick (MFG 1992; Camp Dresser & McKee 1986). Valley soils are found within and along the flanks of Beaver Creek below the confluence with Dudley Creek, and within and along the lower reaches of Deer Creek, Alder Creek and White Creek, Pony Gulch, and Trail Gulch (not shown), which are drainages that feed into Beaver Creek to the north of the mapped area in Part 1 Figure 3.2-2.

The valley soils typically consist of gravel, sand, and silt deposited on valley bottoms; in some areas, this material is mixed or covered with tailings from milling operations (Umpleby and Jones 1923). Tailings are discussed further in Section 4, Nature and Extent of Contamination.

One to 3 miles upstream of the confluence of Beaver Creek and the North Fork is a series of subcircular deposits of terrace gravels; these deposits are mixtures of sand and gravel that exist as benches up to 1,200 feet topographically above nearby streams (Umpleby and Jones 1923).

2.1.5 Ore Deposits

The Beaver Creek Watershed drains a portion of the Carlisle-Hercules Mineral Belt and the Sunset Mineral Belt (Part 1, Figure 3.2-3). Ore deposits in Beaver Creek Watershed are primarily lead-zinc-silver fissure-vein deposits, which are typically steeply dipping veins hosted by argillite or quartose argillite of the Prichard Formation. Most of the fissure-veins occur in faults. Zinc and lead were the most abundant metals produced.

The principal ore minerals are galena and sphalerite. Galena is the primary ore mineral of both lead and silver, and sphalerite is the primary ore mineral of zinc. Associated sulfide minerals are commonly pyrite and pyrrhotite, with lesser amounts of arsenopyrite. Non-ore gangue minerals are quartz, siderite, and ankerite, in order of decreasing abundance. An apparently unique occurrence of the tungsten mineral scheelite with the gangue mineral quartz was noted at the Pony Mine.

Total sulfide content is relatively low (perhaps on the order of 3 to 5 percent or less), based on a review of deposit descriptions (IGS 1999) and the carbonate mineral content (i.e., siderite and ankerite) is less than 3 to 5 percent or nonexistent.

2.1.6 Mining History

A brief summary of available information on historical mining activities is presented in this section. During the RI/FS process, an extensive list of mines, mills, and other source areas was developed based on a list originally developed by the Bureau of Land Management (BLM 1999). This list is presented in Section 4.1, Nature and Extent, and in Appendix I.

In 1907, the Idora Mine became the first mine with recorded production in the watershed. Production records indicate that there were twelve producing mines in this area. However the history of many of the mines is unclear, as many of the mines were consolidated over time. In 1940, the Monitor Mining Company was formed through the consolidation of assets of the Ray

Jefferson, Blue Grouse and Amazon-Manhattan Mining Companies. It was at this time that the Ray Jefferson Mine and Mill were renamed the Carlisle (IGS 1994 through 1997). The company is also reported to have controlled the Silver Tip and Tuscombia mines (SAIC 1993). In October 1947, the Monitor Mining Company was consolidated with eleven other companies to form Day Mines, Inc (IGS 1994 through 1997). Day Mines also controlled the Idora and Nepsic mines (SAIC 1993).

The Carlisle Mill is the only major concentration mill known to have operated in the Beaver Creek Watershed. Ore from the mines of the Monitor Mining Company is reported to have been shipped to the Hercules, Dayrock, and Carlisle flotation mills (IGS 1994 through 1997). Prior to the construction of the Carlisle Mill (Ray Jefferson) in 1916 (IGS 1994 through 1997), early ore production in the watershed may have been hand sorted or jigged or shipped to unrecorded locations for processing.

Production records for the Beaver Creek Watershed indicate that an estimated 2.14 million tons of ore were mined in the area from 1907 to 1977 (Mitchell and Bennett 1983; SAIC 1993). From this ore, an estimated 47,795 tons of lead, 42,366 tons of zinc, 1,498 tons of copper, 62 tons of silver, and 95 pounds of gold were produced. Tailings production associated with this ore has been estimated at nearly 2 million tons (SAIC 1993). Because some ores were milled outside the watershed, not all tailings were disposed of within the reach where the ores were mined.

The following sections provide additional details of the mining history of the Beaver Creek Watershed. These sections contain historical information for specific mines and mills that operated within this area.

2.1.6.1 Mines

The mines that operated in the Beaver Creek Watershed for which ore production was recorded are listed in Table 2.1-1. This table includes the production years of the mine, estimated volumes of ore and tailings produced as a result of the mining activity, and the segment in which the mine is located. Only mines with documented ore production are listed. Additionally, some mining company operations were carried out at more than one location, occasionally in more than one segment or even more than one watershed. The ore production listed in Table 2.1-1 is the total production for all mining operations.

2.1.6.2 Mills

Table 2.1-2 lists the mills with operations in the Beaver Creek Watershed for which there are records. This table includes the operating years of the mill and a summary of ownership, and the segment in which the mill is located. Not all mills are listed, as records were not available for all mills. BLM has identified the Jenkins prospect and Kenan Group adjacent millsites, but no records are currently available for these sites.

2.1.7 Mine Workings

Underground workings in many mines can be extensive and act as collection and distribution systems for groundwater. Individual mine workings in this watershed are typically located along a single, relatively steep ridge.

Many adits and tunnels in this watershed could act as discharge points for groundwater. Typically adit drainage discharges to surface water or first infiltrates waste rock piles before discharging to surface water from seeps. Several adits and tunnels that are known to discharge mine drainage in this watershed were identified by the BLM (1999).

2.2 HYDROGEOLOGY

2.2.1 Conceptual Hydrogeologic Model

The Beaver Creek Watershed occupies approximately 44.1 square miles, and Beaver Creek flows approximately 12 miles from its headwaters in the Bitterroot Mountains to its confluence with the North Fork Coeur d'Alene River (North Fork). The elevation change in the watershed is approximately 3,600 feet, ranging from 6,000 feet above mean sea level (msl) in the Bitterroots to 2,400 feet above msl at the confluence with the North Fork (Part 1, Figure 1.2-2).

The hydrogeology of the Beaver Creek Watershed can be divided into two main groundwater systems: the bedrock aquifer and the shallow alluvial aquifer. The conceptual hydrogeologic model for the watershed assumes that a single unconfined aquifer is present in the shallow alluvial sediments, and these sediments are the principal hydrostratigraphic unit in the watershed. The shallow alluvial sediments consist of natural materials as well as mine tailings and waste rock. In general, the alluvium increases in thickness from the headwaters of Beaver Creek toward its confluence with the North Fork (Umpleby and Jones 1923). Very little specific hydrogeologic data are available for the Beaver Creek Watershed.

The bedrock aquifer within the Beaver Creek Watershed consists of argillites and quartzites of the Precambrian formations of the Belt Supergroup, including (principally) the Prichard and Wallace Formations, and lesser amounts of the, Burke, Revett and St. Regis Formations (Umpleby and Jones 1923). In general, the bedrock has very low permeability. Secondary features such as fractures, faults, or mine workings may increase the permeability substantially.

The groundwater system of unconsolidated sediments overlying less permeable rocks occurs primarily in an elongate trough along Beaver Creek, and varies in shape between V-shaped (e.g., between the headwaters in the Bitterroots to a point roughly 3 miles above the town of Delta) to U-shaped (e.g., between 3 miles above Delta and the confluence with the North Fork) (Part 1, Figure 1.2-2) (Umpleby and Jones 1923). The width of the trough is as narrow as about 200 feet in the reach over 3 miles above Delta, and is as wide as approximately 1,500 feet in the vicinity of Delta (Part 1, Figure 1.2-2) (Umpleby and Jones 1923).

As observed in wells in the Canyon Creek and Ninemile Creek Watersheds, it is assumed that groundwater levels fluctuate seasonally. Groundwater levels are generally highest in the late spring and lowest during winter and early spring when precipitation rates are lowest and snowmelt is not occurring.

2.2.2 Aquifer Parameters

Aquifer parameters are not available for the unconfined aquifer in sediments overlying bedrock. However, based on reported lithologic similarities with the upper aquifer of the Smelterville Flats-Bunker Hill aquifer system, it is reasonable to expect that aquifer parameters presented in Table 2.2-1 would be similar to those found in Beaver Creek. The range of horizontal hydraulic conductivities presented in Table 2.2-1 are typical of clean sand and gravels (Freeze and Cherry 1979).

2.2.3 Flow Rates and Directions

Based on similar watersheds (e.g., Canyon Creek and Ninemile Creek), it can be assumed that the general groundwater flow direction in the Beaver Creek Watershed parallels the flow of Beaver Creek surface water. There are probably localized areas in Beaver Creek where the flow direction is downstream toward the creek and some areas where the flow direction is downstream, away from the creek.

It is assumed that groundwater in Beaver Creek has a fairly steep gradient generally following the ground surface topography (Part 1, Figure 1.2-2). The gradient of 0.035 calculated for the

Woodland Park area of Canyon Creek is probably comparable to the lower reaches in Beaver Creek.

2.2.4 Surface Water/Groundwater Interaction

No information is available on the surface water/groundwater interaction.

2.2.5 Groundwater Use

Use of groundwater supplies for domestic, municipal, and industrial applications (as it relates to human consumption) is discussed in the baseline human health risk assessment.

2.3 SURFACE WATER HYDROLOGY

The following sections describe the surface water hydrology of Beaver Creek, a tributary to the North Fork. The basin has a drainage area of approximately 44.1 square miles, with approximately 12 miles of mapped channel.

2.3.1 Available Information

Stream discharge measurements were taken in association with water quality sampling events completed by URS and the U.S. Geological Survey (USGS). These measurements occurred from May 5, 1998 to May 24, 1999. These data are summarized in Table 2.3.1-1. Refer to Figure 4.1-2 for sampling locations.

The U.S. Department of Housing and Urban Development, Federal Insurance Administration completed a flood insurance study for the Shoshone County, Idaho in 1979 (FIA 1979). This document reported computed peak discharges for 10-year (1,730 cubic feet per second [cfs]), 50-year (2,950 cfs), 100-year (3,605 cfs) and 500-year (5,480 cfs) events near the mouth of Beaver Creek. These data are summarized in Table 2.3.1-2. Although these values reported might be dated and coefficients used to calculate these discharges may contain some error, they do provide some basis for selecting a design discharge for remedial actions.

In addition to the water quality sampling data and the flood insurance study data, the USGS reported data for one gage in the vicinity of Beaver Creek with discharge data from 1999 (USGS station number 12411935, Prichard Creek above mouth at Prichard, ID [USGS 2000]). The

Prichard Creek gage has a drainage area of 97.8 square miles. This data can be extrapolated to estimate hydrographs for Beaver Creek.

2.3.2 Hydrologic Description

This section describes the hydrology of Beaver Creek based on estimates of discharge calculated from measured discharge in Prichard Creek from water year 1999 and the flood insurance study

2.3.2.1 Flood Frequency

Because historical discharge data are not available for Beaver Creek, discharge estimates from the flood insurance study are reported. These estimates are presented in Table 2.3.1-2. The values shown in Table 2.3.1-2 are larger than the extrapolated maximum mean daily discharge for water year 1999 and may provide guidance for design of remedial actions. The bankfull discharge, the approximately 1.5 year event, is estimated to be 500 cfs.

2.3.2.2 Water Year 1999

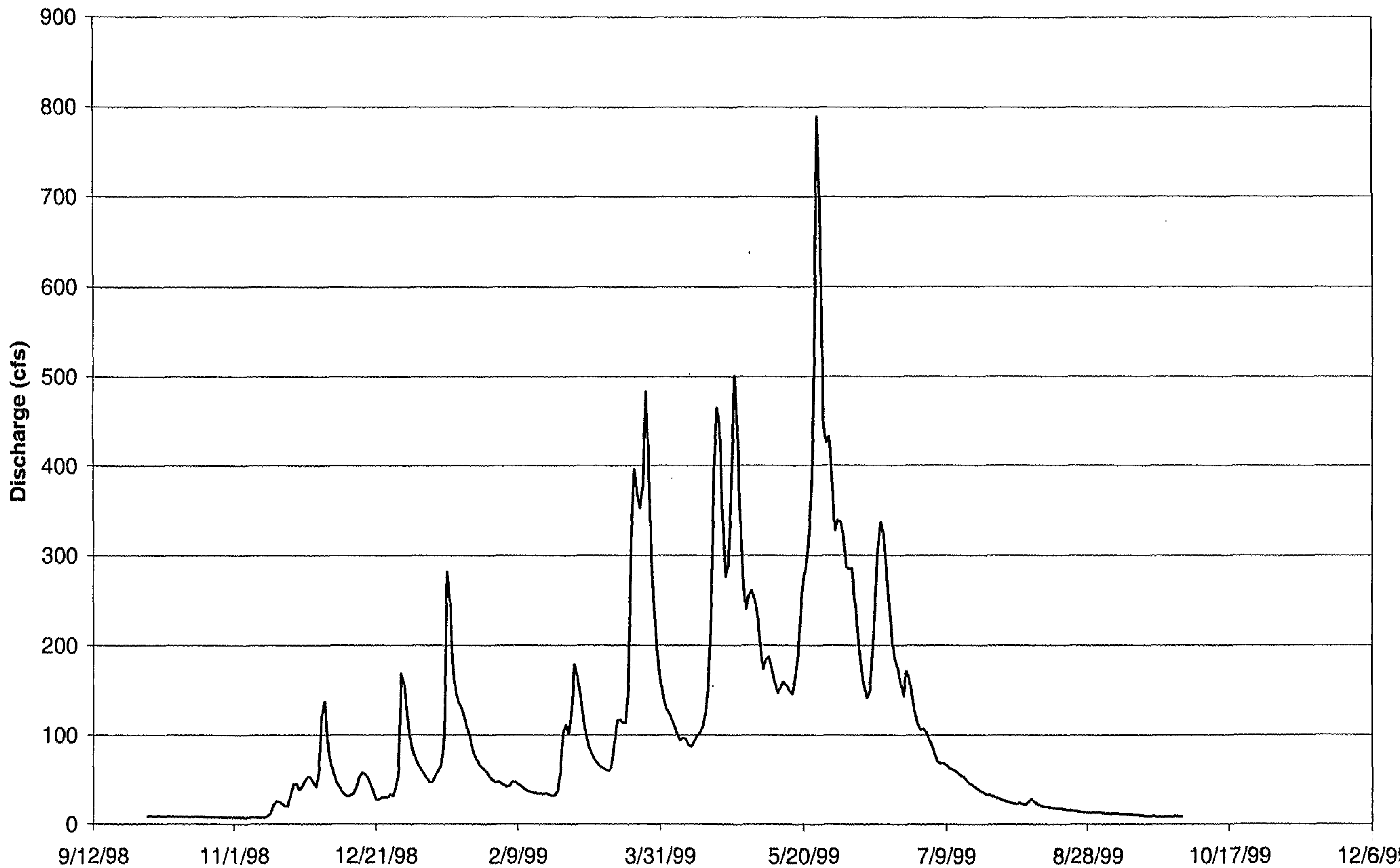
The USGS has one gage in the vicinity of Beaver Creek with measured discharge for water year 1999, Prichard Creek. The Prichard Creek gage has a drainage area of approximately 97.8 square miles. To estimate discharge in Beaver Creek, the mean daily discharge in Prichard Creek was scaled by the ratio of Beaver Creek drainage area to Prichard Creek drainage area. The estimated hydrograph is presented in Figure 2.3.2-1.

From Figure 2.3.2-1, maximum mean daily discharge for water year 1999 was 789 cfs and occurred on May 25, 1999. Average annual discharge is estimated at about 100 cfs. Minimum daily discharge was approximately 7 cfs. Baseflow is estimated to be between 5 and 10 cfs. The discharge measurement presented in Table 2.3.1-1 are consistent with the extrapolated estimates of discharge for water year 1999 shown in Figure 2.3.2-1.

The increase in discharge during the spring and summer is attributed to increased runoff caused by snowmelt. Increased temperatures over these periods melted much of the snow in the upper basin. Rain on snow also may have contributed to these increases where precipitation events also occurred during periods of increased temperature.

Based on the existing data, it is expected that water year 1999 was typical from a total snowfall and total water budget perspective in the Beaver Creek Watershed. Runoff from spring snowmelt dominates the surface water hydrology. Variations in snowfall, temperature, and rainfall from year to year will influence the magnitude and timing of peak discharges.

Estimated Mean Daily Discharge for Beaver Creek, Based on Prichard Creek Measurements, Water Year 1999



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Beaver Creek Series 07/11/01	Figure 2.3.2-1

Table 2.1-1
Mines in the Beaver Creek Watershed With Recorded Production

Segment	Production Years[a]	Ore (tons)[b]	Mill	Tailings (tons)[b]	Comments
Amazon Mine (includes Monitor, Parrot)					
BvrCrkSeg01	1912-1977	1,287,907	Hercules, Dayrock, and Carlisle	1,236,657	Production records for the Amazon Mine date back to 1912 (Mitchell and Bennett 1983). By 1917 the Amazon Mine was being developed by Day interests. An aerial tramway was installed to carry ore from the mine to the Ray Jefferson Mill. In 1940, the mine was consolidated with other Beaver Creek holdings of the Day family to form the Monitor Mining Company. The Amazon Mine had apparently been closed, as it was reported to have been reopened by the Monitor Mining Company in 1944. Work is reported to have continued through 1947. About this time, the Monitoring Mining Company was again consolidated to form Day Mines, Inc. After 1955, most work performed at the mine was done by lessees (SAIC 1993). Records indicate that the mine continued to be a producer through 1977 (Mitchell and Bennett 1983).
Blue Grouse Mine					
BvrCrkSeg01	1952-1969	2,747		2,177	In December 1940, the Monitor Mining Company was formed through the consolidation of the assets of the Ray Jefferson, Blue Grouse and Amazon-Manhattan Mining Companies (IGS 1994 through 1997). Production records for the Blue Grouse Mine indicate that the mine began producing in 1952 (Mitchell and Bennett 1983). Day Mines terminated operations at the Monitor Group on November 30, 1952 (IGS 1994 through 1997); therefore, it is assumed that most of the production at the Blue Grouse can be attributed to lessees. The mine continued to produce through 1969 (Mitchell and Bennett 1983).

Table 2.1-1 (Continued)
Mines in the Beaver Creek Watershed With Recorded Production

Segment	Production Years[a]	Ore (tons)[b]	Mill	Tailings (tons)[b]	Comments
Carlisle Mine					
BvrCrkSeg01	1942-1947	78,963	Carlisle	76,436	The Carlisle Mine is located on the Carbon Creek tributary of Beaver Creek. The mine was originally named the Ray Jefferson Mine. In 1915, a substantial body of lead-zinc ore was developed at the mine. Records indicate that shipments were made from the mine in 1917 and 1918 and that some tunnel work was done at the mine in 1930. In 1940, the Monitor Mining Company was formed by the consolidation of assets from the Ray Jefferson, Blue Grouse, and Amazon-Manhattan Mining Companies. It was at this time that the Ray Jefferson became the Carlisle Mine. Monitoring Mining operated the Carlisle between 1944 and 1947, before being consolidated with several other mines to form Day Mines, Inc. About this time, ore production for the Carlisle was typically reported with several other mines as the Monitor group. In 1951, the Monitor group was the largest producer of ore in the Beaver district. Day Mines ceased operations for the Monitor group in 1952 due to low metals prices (IGS 1994 through 1997).
Idora Mine					
BvrCrkSeg01	1907-1949	12,509		10,588	Records indicate that the Idora Mine was an active producer by 1907 (Mitchell and Bennett 1983). The mine apparently became inactive about 1917. About this time, the mine was owned by the Idora Mining Company Ltd. The mine is reported to have been worked by lessees in 1927. In 1934, the Idora Mining Company Ltd. was consolidated with the Tuscumbia to form the Consolidated Mining Corp. Later in 1940, these properties were sold to the Prime Western Metals Company. Day Mines, Inc. eventually acquired the property (SAIC 1993). The mine is reported to have produced until 1949 (Mitchell and Bennett 1983).

Table 2.1-1 (Continued)
Mines in the Beaver Creek Watershed With Recorded Production

Segment	Production Years[a]	Ore (tons)[b]	Mill	Tailings (tons)[b]	Comments
Mountain Goat Mine					
BvrCrkSeg01	1955-1970	344,674		299,108	Records indicate that the Mountain Goat Mine began producing in 1955 (Mitchell and Bennett 1983). The mine was apparently controlled by Day Mines, Inc. but was operated by the Zanetti Brothers through a lease agreement (SAIC 1993). The mine ceased production in 1970 (Mitchell and Bennett 1983).
Nepsic Mine					
BvrCrkSeg01	1943-1947	10,475		7,893	Records indicate that the Nepsic Mine began producing in 1943 (Mitchell and Bennett 1983). The mine was apparently controlled by Day Mines, Inc. or one of its predecessors, but was operated by the Callahan Mining Corporation through a lease agreement (SAIC 1993). The mine ceased production in 1947 (Mitchell and Bennett 1983).
Pony Gulch Mine					
BvrCrkSeg01	1934-1942, 1950	1,095		1,090	The Pony Gulch Mine is located approximately 2 miles up Pony Gulch in the Beaver Creek Watershed. The property was controlled by the Kennan Mining Company from 1917 to sometime in the mid-1930s when ownership of the property was passed to a partnership. In 1923, the mine workings consisted of nineteen tunnels ranging in length from 10 to 350 feet and one shaft. In 1938, the property was leased to Ben Johnson and J.D. Chapin of Wallace, Idaho. Later, Chapin became the sole lessee, and in 1940 he shipped gold ore from the mine. From 1953 to 1954, the mine was explored by lessees for tungsten under a DMEA loan. The originally planned work for this project was never completed (IGS 1994 through 1997).

Table 2.1-1 (Continued)
Mines in the Beaver Creek Watershed With Recorded Production

Segment	Production Years[a]	Ore (tons)[b]	Mill	Tailings (tons)[b]	Comments
Ray Jefferson Mine					
BvrCrkSeg01		130	Carlisle	61	The Ray Jefferson Mine was renamed the Carlisle Mine in 1940 (IGS 1994 through 19997). See Carlisle Mine above.
Silver Tip Mine					
BvrCrkSeg01	1941-1959	30,255		25,207	Production records indicate that the Silver Tip was a producing mine by 1941 (Mitchell and Bennett 1983). About this time, the mine was controlled by the Monitor Mining Company, and at least one lessee operated the property in 1944 (SAIC 1993). The last recorded production for the Silver Tip was in 1959 (Mitchell and Bennett 1983).
Sunset Lease Mine					
BvrCrkSeg01	1913-1976	355,032		302,863	Shipments of ore from the Sunset Lease property began in 1913 (Mitchell and Bennett 1983). In 1933, it was reported that the mine was owned by the Anaconda Copper Mining Company and that the mine was idle. Independents leased the mine from 1944 to 1949. In 1950, Day Mines, Inc. obtained a lease on the property. Day Mines, Inc. then subleased the mine to Karsage and Zanetti, who mined the property until 1964. Anaconda Copper Mining Company was still listed as the owner of record in 1964 (SAIC 1993). The mine continued to be a producer until 1976 (Mitchell and Bennett 1983).
Tough Nut Mine					
BvrCrkSeg01	?	1,448		1,303	Little is known of the operating history of the Tough Nut Mine. The mine produced 1,448 tons of ore during its production history (Mitchell and Bennett 1983). In 1993, it was reported that the mine was owned by the Hecla Mining Company. Apparently the mine was acquired by Hecla through a merger with Day Mines, Inc. (SAIC 1993).

Table 2.1-1 (Continued)
Mines in the Beaver Creek Watershed With Recorded Production

Segment	Production Years[a]	Ore (tons)[b]	Mill	Tailings (tons)[b]	Comments
Tuscombia Mine					
BvrCrkSeg01	1911-1956	12,632		10,780	Records indicate that the Tuscumbia Mine was a producer by 1911 (Mitchell and Bennett 1983). In 1940, the mine was purchased by the Prime Western Metals Company. It was later acquired by the Monitor Mining Company and then by Day Mines, Inc. through a consolidation of the Monitor and other mining companies in 1947 (SAIC 1993). The mine continued to produce until 1956 (Mitchell and Bennett 1983).

[a]Source: Mitchell and Bennett 1983
[b]Source: SAIC 1993

Notes:
Blank cells indicate that there was most likely no mill located on site, and ores were probably shipped elsewhere for milling. No records were found identifying the mill to which the ores were shipped.
Estimated tailings produced by each mine were not necessarily disposed of within the reach where the ores were mined.

Table 2.1-2
Mills With Documented Operations in Beaver Creek Watershed

Segment	Operating Years	Ownership	Comments
Carlisle Mill			
BvrCrkSeg01	1916-1952 (IGS)	Ray Jefferson Mining Company, Monitor Mining Company, Day Mines, Inc. (IGS)	A 400-ton flotation mill was completed at the Ray Jefferson Mine in 1916. Some ore was processed at the mill and stored awaiting completion of the Beaver branch of the Oregon-Washington Railroad and Navigation Co. railway. The Monitor Mining Company acquired control of the mill in 1940 after the consolidation of assets from the Ray Jefferson, Blue Grouse, and Amazon-Manhattan Mining Companies. At this time, the name of the mill was changed to the Carlisle mill. After 1948, the mill was operated by Day Mines, Inc., who acquired the property through another consolidation of several mining companies. In 1948 and 1951, there is some historical reference to ores being treated at 500-ton and 300-ton Carlisle Mill respectively. It is unclear whether either of these mills is associated with the original 400-ton mill on the property, or when they were constructed. There is no record of the mill operating after 1952 (IGS 1994 through 1997).

Table 2.2-1
Summary of Aquifer Parameters of the Smelterville Flats-Bunker Hill Upper Aquifer

Hydrostratigraphic Unit	Horizontal Hydraulic Conductivity (ft/day)	Vertical Hydraulic Conductivity (ft/day)	Transmissivity 2 (ft/day)	Storativity (unitless)	Effective Porosity
Upper Aquifer	500 - 10,790	0.0025[a]	10,002-216,852	0.0015-0.09	23.6-29.0

[a]Based on one test conducted on a sample of upper aquifer alluvium from borehole GR-26U at 13.5 feet below ground surface. No units given in original source document.

Source: MFG (1992)

Table 2.3.1-1
Summary of Discharge Data From Project Database
Segment BvrCrkSeg01

Segment Name	Site Location		Measured By	No. of Readings	Beginning Date	Ending Date	Minimum Discharge	Maximum Discharge	Units
BvrCrkSeg01	BV	1	URS, USGS	2	05/05/98	05/24/99	85.6	141	cfs
BvrCrkSeg01	BV	3	URS	1	05/05/98	05/05/98	72.4	72.4	cfs
BvrCrkSeg01	BV	4	URS	1	05/06/98	05/06/98	3.92	3.92	cfs
BvrCrkSeg01	BV	5	URS	1	05/06/98	05/06/98	1.27	1.27	cfs
BvrCrkSeg01	BV	6	URS	1	05/05/98	05/05/98	73	73	cfs
BvrCrkSeg01	BV	7	URS	1	05/06/98	05/06/98	5.55	5.55	cfs
BvrCrkSeg01	BV	8	URS	1	05/11/98	05/11/98	1.62	1.62	cfs
BvrCrkSeg01	BV	9	URS	1	05/06/98	05/06/98	33.8	33.8	cfs
BvrCrkSeg01	BV	10	URS	1	05/11/98	05/11/98	0.221	0.221	cfs
BvrCrkSeg01	BV	11	URS	1	05/11/98	05/11/98	4.57	4.57	cfs
BvrCrkSeg01	BV	12	URS	1	05/11/98	05/11/98	9.83	9.83	cfs

cfs - cubic feet per second

Table 2.3.1-2
Estimated Recurrence Intervals, Flood Insurance Study, Beaver Creek

Recurrence Interval (Years)	Flood Insurance Study Beaver Creek at Mouth Estimated Peak Flow (cfs)
2	not available
5	not available
10	1,730
25	not available
50	2,915
100	3,605

cfs - cubic feet per second

3.0 SEDIMENT TRANSPORT PROCESSES

The physical processes of rain falling on soil, runoff from snowmelt or precipitation, channel bank and bed erosion, or mass movements incorporates sediment into streams of water. Water in streams transports, deposits, and sorts the delivered sediment based on the stream energy, discharge, and size and quantity of sediment.

Sediment transport by streams is a natural process; however, human activities such as mining, logging, road building, urbanization, or land clearing can significantly increase the rate at which sediment transport occurs. For instance, land clearing provides exposed soil and rock that may be subject to erosion. Further, this disturbance may decrease the amount of water storage in the soil, increasing runoff rates and providing additional surface water and energy for sediment transport.

The rate at which sediment passes through a cross section of a stream system is referred to as the sediment yield. For purposes of this report, sediment yield will be referred to in units of tons per square mile per year. This annual sediment yield may be broken down into components that describe the method of transport, suspended load and bed load. Suspended load consists of particles small and light enough to be carried downstream in suspension by shear and eddy forces in the water column. Bed load consists of larger and heavier particles that move downstream by rolling sliding or hopping on the channel bed (Dunne and Leopold 1978).

All sediment motion downstream is dictated by the shear and gravitational forces acting at a given time and place within the channel. For sediment transport purposes, gravitational forces are essentially constant. Shear forces, however are dynamic through space and time and are dependent upon the location, depth of water, and slope of the water surface. Sediment transport occurs at even the smallest of stream channel discharge but the majority of movement occurs during moderate to high discharge when shear forces are greatest (Leopold et al. 1992).

Sediment derived in Beaver Creek is transported to the North Fork. Based on review of aerial photographs, potential sediment sources within the Beaver Creek Watershed include mining waste, mobilization of channel bed sediment and bank erosion. Logging and other dirt exploration roads may also provide a sediment source. In this discussion, the available information, analyses, and likely sediment sources are described.

3.1 AVAILABLE INFORMATION

For the Beaver Creek watershed, 1998 photographs by URS Greiner, Inc. (URSG) and CH2M HILL (URSG and CH2M HILL 1999) were reviewed. USGS sediment gaging data are not available for Beaver Creek; therefore, estimates of sediment yield are not included in this discussion.

3.2 ANALYSES

3.2.1 Channel Descriptions

The 1998 set of aerial photographs by URSG and CH2M HILL were reviewed to describe Beaver Creek. Available photographic coverage of Beaver Creek extends upstream of the sweeping bend in the Beaver Creek Valley, where the valley trends east-west, approximately 6.7 miles upstream of the confluence with the North Fork. This review and interpretation focused on morphologic features indicating stream instability, channel migration, channel aggregation or degradation and other features that may contribute sediment to the system.

Beaver Creek, upstream of the bend in valley, for a length of approximately 4,500 feet, is situated in a valley approximately 200 feet wide. The valley floor is moderately well vegetated with conifers. Some areas in this section display a braided pattern and contain relict channels. Logging and other dirt roads criss cross the hillslope to the north of this section.

Upstream, the valley widens to approximately 1,000 feet. Vegetated tailings dams are located in the upstream portion of the widened valley. The channel displays a braided and meandering pattern through this section.

Upstream of the tailings dams, Beaver Creek splits into two forks, photographic coverage is only available for the southern fork. The southern fork is confined in a narrow valley. Logging and other dirt roads criss cross the hillslopes surrounding Beaver Creek in this section. A few rock piles from mines or natural rockfall are also situated on the hillslopes above Beaver Creek.

3.3 SUMMARY

The Beaver Creek Watershed appears to have few sediment sources. Likely sediment sources throughout the basin include tailings deposits, logging and other dirt roads, channel bed remobilization, and minor bank erosion. These appear less significant than other areas in the Coeur d'Alene River Basin.

These observations were based on a limited review of the available data, photographs, and topographic maps at the time of review. Not all potential sediment sources were identified, as potential sediment sources literally cover the entire watershed. Primary sources were identified based on review of the available information.

4.0 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination and mass loading in the Beaver Creek watershed are discussed in this section. Section 4.1 describes chemical concentrations found in environmental media, including horizontal and vertical extent. The discussion includes remedial investigation data chemical analysis results; comparison of chemical results to selected screening levels; and focused analysis of identified source areas. In Section 4.2, preliminary estimates of mass loading are presented.

4.1 NATURE AND EXTENT

The nature and extent of the ten metals of potential concern identified in Part 1, Section 5.1 (antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, silver, and zinc) in surface soil, subsurface soil, sediment, groundwater and surface water are discussed in this section. Locations with metals detected in any matrix at concentrations 1 times (1x), 10 times (10x) and 100 times (100x) the screening level were identified and presented in the following data summary tables. The magnitudes of exceedance (10x and 100x) were arbitrarily selected to highlight potentially significant areas of contamination.

Historical and recent investigations at areas within the study area are listed and summarized in Part 1, Section 4. Data source references are included as Attachment 1. Chemical data collected in Beaver Creek and used in this evaluation are presented in Attachment 2. Data summary tables include sampling location, data source reference, collection date, depth, and reported concentration. Screening level exceedances are highlighted. Sampling locations are shown on Figures 4.1-1 and 4.1-2.

The nature and extent of contamination were evaluated by screening chemical results against applicable risk-based screening criteria and available background concentrations. Screening levels are used in this analysis to identify source areas and media (e.g., soil, sediment, groundwater, and surface water) of concern that will be evaluated in the feasibility study (FS).

Statistical summaries for each metal in surface soil, subsurface soil, sediment, groundwater, and surface water are included as Attachment 3 and discussed in the subsections below. The summaries include the number of samples analyzed; the number of detections; the minimum and maximum detected concentrations; the average and coefficient of variation; and the screening level (SL) to which the detected concentration is compared. Proposed screening levels were compiled from available federal numeric criteria (e.g., National Ambient Water Quality Criteria), regional preliminary remediation goals (PRGs) (e.g., U.S. EPA Region IX PRGs), regional baseline or background studies for soil, sediment, and surface water, and other guidance documents (e.g., National Oceanographic and Atmospheric Administration freshwater sediment screening values). Screening level references and selected screening levels are included in Attachment 4. The screening level selection process is discussed in detail in Part 1, Section 5.1.

Potential source areas within Beaver Creek are presented in Table 4.1-1. These sites are based on source areas initially identified by the BLM (1999) and further refined during the RI/FS process. The table includes source area names, source ID, source area acres, description, number of samples by matrix type, and metals exceeding 1x, 10x, and 100x the screening levels in surface soil, subsurface soil, sediment, groundwater, and surface water.

It should be noted that the number of samples identified for each source area was determined using the project Geographical Information System. Only sampling locations located within a source area polygon (shown on Figures 4.1-1 and 4.1-2) are included in Table 4.1-1; therefore, there may be samples collected from source areas and listed in the data summary tables in Attachment 2 that are not accounted for in Table 4.1-1

The following sections present segment-specific sampling efforts and results according to matrix type. Given the extensive geographic range of the Coeur d'Alene Basin, sampling efforts were focused on areas of potential concern; therefore, more samples were collected from known mining-impacted areas near the creek, than from other areas within the watershed.

4.1.1 Segment BvrCrkSeg01

4.1.1.1 Surface Soil

Ten surface soil samples were collected and analyzed for total metals in segment BvrCrkSeg01. Arsenic, lead and zinc were detected at concentrations greater than 10x the screening level with one lead concentration greater than 100x the screening level in surface soil.

4.1.1.2 Surface Water

Twenty-six surface water samples were collected and analyzed for dissolved metals and twenty-seven total metals in segment BvrCrkSeg01. Results for dissolved metals show concentrations greater than 10x the screening level of cadmium and zinc, and one sample with high levels of zinc greater than 100x the screening level.

4.1.1.3 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, groundwater, and surface water were reviewed together to identify source areas within segment BvrCrkSeg01 that may be significant contributors of metals to Beaver Creek. Summary source area data are presented in Table 4.1-1. Four of the 74 source areas in this segment were sampled for surface soil and six were sampled for surface water.

4.2 SURFACE WATER MASS LOADING

In Part 1 of this report (Setting and Methodology, Section 5.3.1), the concept of mass loading and its use in the remedial investigation were presented. Section 4.2 of the Canyon Creek Nature and Extent further discussed the use of the plotting discrete sampling events versus the probabilistic analysis of the mass loading data in Fate and Transport.

This section presents the instantaneous mass loading measurements made in Beaver Creek. The measurements show variations in mass loading in the stream system relative to source areas. The sampling data selected are not intended to represent all the available mass loading data. Data are limited for Beaver Creek. Table 4.2-1 lists the majority of data available. The remainder of this section presents the indicator metal correlation and selected maps with a discussion of discrete sampling.

4.2.1 Indicator Metal Correlation

In Section 4.2 of the Canyon Creek Watershed Nature and Extent, the correlation of chemical concentrations for 8 chemicals of potential concern (COPCs) to total lead and dissolved zinc are evaluated. These two metals appear to be reasonable indicators of the other chemicals of potential concern. The following mass loading discussion is limited to total lead and dissolved zinc.

4.2.2 Beaver Creek Watershed Mass Loading

Of the available sampling data, data for May 1998 were the most abundant. Table 4.2-1 summarizes the sampling event data. Results of the instantaneous mass loading analysis are discussed in this section.

4.2.2.1 Total Lead Mass Loading

Loading observations are as follows:

Sampling locations are shown on Figure 4.1-2. As shown in Table 4.2-1, total lead loading is very low with the highest load being 1 pound per day at sampling location BV6. Mass load for pond and adit concentrations could not be calculated because the discharge was less than 1 cfs, but concentrations of lead ranged from 14 to 24 micrograms per liter.

4.2.2.2 Dissolved Zinc Mass Loading

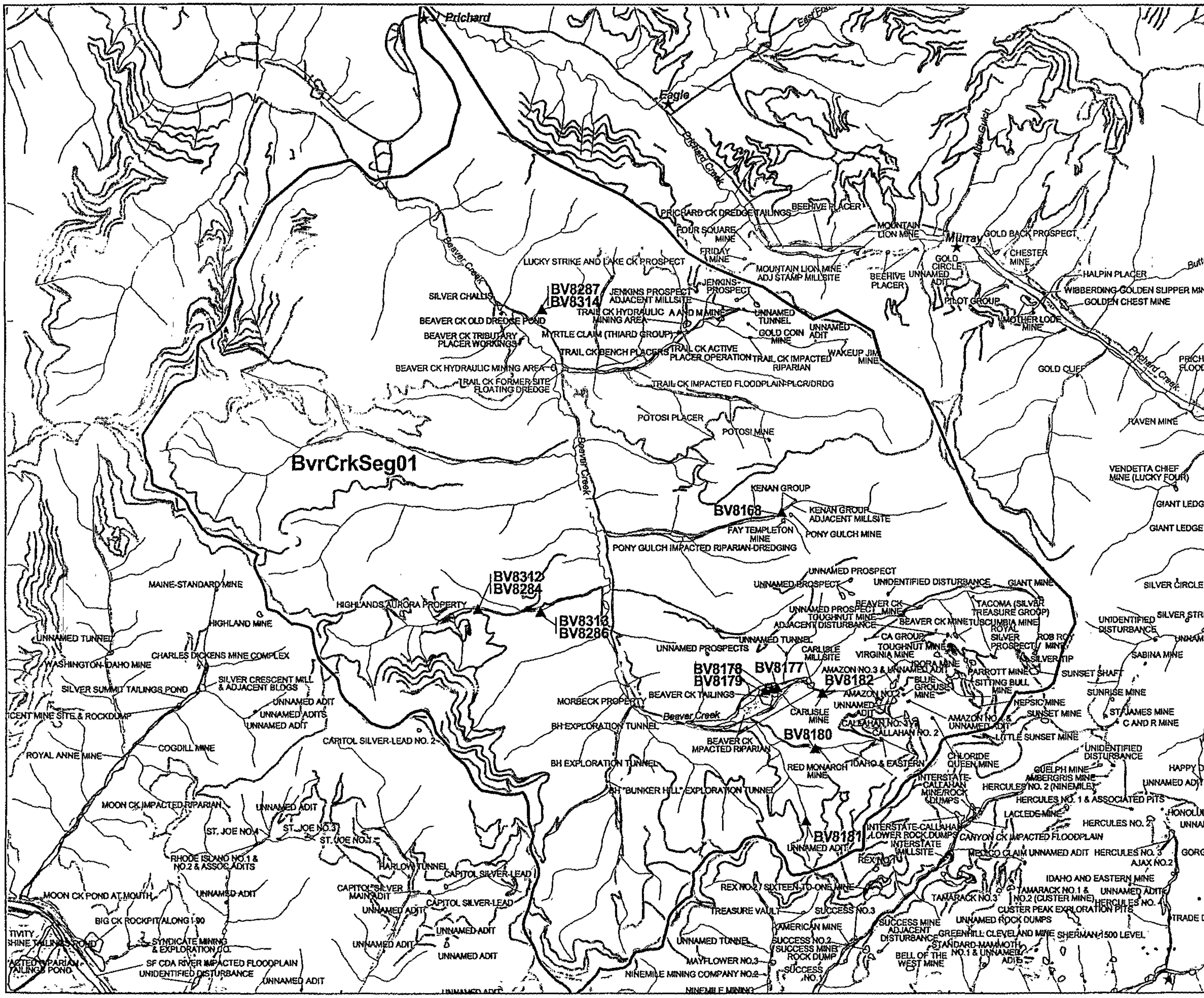
Loading observations are as follows:

Sampling locations are shown on Figure 4.1-2. As shown in Table 4.2-1, dissolved zinc loading ranged from 9 to 72 pounds per day, with the highest load at sampling location BV9. This sampling location is downstream of the Beaver Creek Tailings Pond. Farther downstream, the zinc load decreases to 42 pounds per day at sampling location BV6 and 24 pounds per day at BV3. Near the confluence with the North Fork (BV1), the zinc load is 45 pounds per day (from USGS reported result for May 24, 1999). Lake and adit loads could not be calculated, but concentrations of zinc ranged from 400 to 6,600 micrograms per liter.

4.2.2.3 Groundwater Mass Loading

Groundwater in Beaver Creek has not been adequately characterized to develop mass loading information. However, the loss of dissolved zinc load in the lower reaches may be indicative of a losing stream reach similar to the Woodland Park area in Canyon Creek.

Figure 4.1-1
Beaver Creek Segment BvrCrkSeg01 Source Areas and Soil/Sediment Sampling Locations



LEGEND

- ▲ Tailings Sampling Location
- Stream
- Road
- ★ City
- Beaver Creek Segment 1
- Source Area and Name

Location Map

Idaho

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:60,000

0 0.5 1 Miles

027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

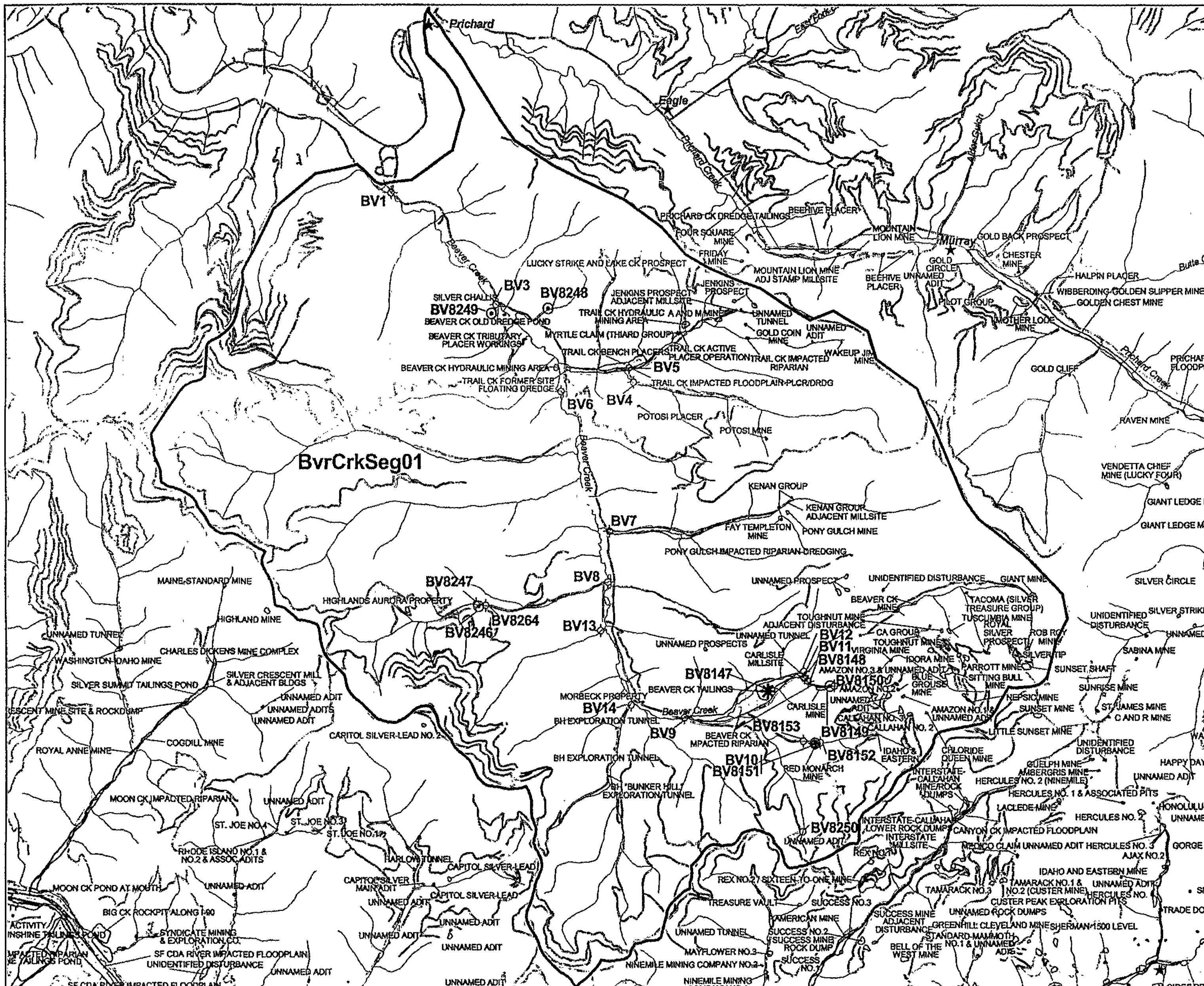
EPA
REGION 10

Doc Control 4162500.6615.05a
Generation 1
n:\Projects\RI_FS\Beaver Creek\beaver_creek_5-1.apr
VIEW:Soil
EXTENT:Soil
LAYOUT: Final RI Soil
7/11/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 11, 2001

Figure 4.1-2
Beaver Creek Segment BvrCrkSeg01 Source Areas and Surface Water Sampling Locations



LEGEND

- Seep Sampling Location
- Adit Sampling Location
- Lake/Pond/Open Reservoir Sampling Location
- River Sampling Location
- Stream
- Road
- City
- Beaver Creek Segment 1
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:60,000

0.5 0 0.5 Miles

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA
REGION 10

Doc Control 4162500.6615.05a
Generation 1
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beaver_creek_5-1.apr
V:Surface Water
E:vsw
L: Final RI Surface Water
7/11/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 11, 2001

Table 4.1-1
Potential Source Areas Within Beaver Creek - segment BvrCrkSeg01

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
A AND M MINE	OSB007	1.42	Floodplain Waste Rock (Above Cataldo No.& So.Fork)				
AMAZON NO.1 & UNNAMED ADIT	BUR163	0.45	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
AMAZON NO.2	BUR161	0.53	Upland waste rock				
AMAZON NO.3 & UNNAMED ADIT	BUR036	2.30	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
BEAVER CK HYDRAULIC MINING AREA	OSB095	1.45	Floodplain Waste Rock (Above Cataldo No.& So.Fork)				
BEAVER CK IMPACTED RIPARIAN	OSB066	68.76	Floodplain sediments (above Cataldo No.& So. Fork)				
BEAVER CK IMPACTED RIPARIAN	OSB067	1.80	Floodplain sediments (above Cataldo No.& So. Fork)				
BEAVER CK MINE	BUR029	0.88	Floodplain Waste Rock (Above Cataldo No.& So.Fork)				
BEAVER CK MINE	BUR158	0.89	Floodplain Waste Rock (Above Cataldo No.& So.Fork)				
BEAVER CK OLD DREDGE POND	OSB102	0.37	Surface Water				
BEAVER CK TAILINGS	OSB019	25.71	Floodplain tailings (above Cataldo No.& So. Fork)	SL 3 SW 2	SST: As-3, Cu-1, Pb-2, Zn-1 SWD: Cd-1, Mn-1, Pb-1, Zn-1 SWT: Cd-2, Fe-1, Mn-1, Pb-1	SST: Pb-1 SWD: Cd-1, Zn-1 SWT: Cu-1, Zn-2	
BEAVER CK TRIBUTARY PLACER WORKINGS	OSB001	0.83	Floodplain Waste Rock (Above Cataldo No.& So.Fork)				
BH "BUNKER HILL" EXPLORATION TUNNEL	OSB091	0.25	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
BH EXPLORATION TUNNEL	OSB092	0.17	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
BH EXPLORATION TUNNEL	OSB093	0.15	Floodplain Waste Rock (Above Cataldo No.& So.Fork) Mine Workings/Water, Seeps, Springs and Leachate				
BLUE GROUSE MINE	BUR162	0.39	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
CA GROUP	BUR030	0.17	Upland waste rock				

Table 4.1-1
Potential Source Areas Within Beaver Creek - segment BvrCrkSeg01

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
CALLAHAN NO. 2	BUR040	1.01	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
CALLAHAN NO. 3	BUR039	1.51	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
CARLISLE MILLSITE	OSB020	1.85	Mine Workings/Water, Seeps, Springs and Leachate Upland Concentrates and Process Wastes	SW 1		SWD: Cd-1, Zn-1 SWT: Cd-1	SWT: Zn-1
CARLISLE MINE	OSB068	2.30		SL 1 SW 1	SST: As-1, Cd-1 SWD: Cu-1, Mn-1 SWT: Mn-1, Pb-1	SST: Pb-1, Zn-1 SWD: Cd-1 SWT: Cd-1	SWD: Zn-1 SWT: Zn-1
CHLORIDE QUEEN MINE	BUR042	0.36	Upland waste rock				
FAY TEMPLETON MINE	OSB015	0.74	Upland waste rock				
GIANT MINE	BUR026	0.92	Upland waste rock				
GOLD COIN MINE	OSB008	0.29	Upland waste rock				
HIGHLANDS AURORA PROPERTY	OSB016	1.19	Upland waste rock				
IDAHO & EASTERN	BUR041	0.35	Floodplain Waste Rock (Above Cataldo No.& So.Fork) Mine Workings/Water, Seeps, Springs and Leachate				
IDORA MINE	BUR034	1.38	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
JENKINS PROSPECT	OSB009	0.57	Upland waste rock				
JENKINS PROSPECT	OSB010	1.23	Upland waste rock				
JENKINS PROSPECT ADJACENT MILLSITE	OSB108	0.26	Upland Concentrates and Process Wastes				
KENAN GROUP	OSB096	0.33	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
KENAN GROUP	OSB098	0.20	Upland waste rock				
KENAN GROUP ADJACENT MILLSITE	OSB097	0.19	Upland Concentrates and Process Wastes				
LUCKY STRIKE AND LAKE CK PROSPECT	OSB003	0.34	Upland waste rock				
MORBECK PROPERTY	OSB017	0.26	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				

Table 4.1-1
Potential Source Areas Within Beaver Creek - segment BvrCrkSeg01

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
MYRTLE CLAIM (THIARD GROUP)	OSB005	0.27	Upland waste rock				
NEPSIC MINE	BUR044	1.58	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
PARROTT MINE	BUR045	0.94	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
PARROTT MINE	BUR046	1.59	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
PONY GULCH IMPACTED RIPARIAN-DREDGING	OSB094	27.63	Floodplain sediments (above Cataldo No.& So. Fork)	SW 1			
PONY GULCH MINE	OSB014	0.53	Upland waste rock				
POTOSI MINE	OSB013	0.40	Upland waste rock				
POTOSI PLACER	OSB006	0.19	Upland waste rock				
RED MONARCH MINE	OSB051	1.08	Floodplain Waste Rock (Above Cataldo No.& So.Fork) Mine Workings/Water, Seeps, Springs and Leachate	SL 1 SW 2	SST: As-1, Pb-1 SWD: Cd-1, Cu-1, Mn-1, Zn-1 SWT: Cd-1, Fe-1, Mn-1	SWD: Cd-1, Zn-1 SWT: Zn-1	SWT: Zn-1
ROB ROY MINE	BUR049	0.72	Floodplain Waste Rock (Above Cataldo No.& So.Fork) Mine Workings/Water, Seeps, Springs and Leachate				
ROYAL SILVER PROSPECT	BUR047	0.87	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
SILVER CHALLIS	OSB002	0.95	Floodplain Waste Rock (Above Cataldo No.& So.Fork)				
SILVER TIP	BUR048	4.12	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
SITTING BULL MINE	BUR043	3.78	Upland waste rock				
SUNSET SHAFT	BUR050	2.97	Mine Workings/Water, Seeps, Springs and Leachate Upland waste rock				
TACOMA (SILVER TREASURE GROUP)	BUR027	0.28	Upland waste rock				
TOUGHNUT MINE	BUR031	0.21	Upland waste rock				
TOUGHNUT MINE ADJACENT DISTURBANCE	BUR032	0.51	Upland waste rock				

Table 4.1-1
Potential Source Areas Within Beaver Creek - segment BvrCrkSeg01

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type		Metals > 1X	Metals > 10X	Metals > 100X
TRAIL CK ACTIVE PLACER OPERATION	OSB103	0.25	Floodplain Waste Rock (Above Cataldo No.& So.Fork)					
TRAIL CK BENCH PLACERS	OSB101	17.70	Floodplain Waste Rock (Above Cataldo No.& So.Fork)					
TRAIL CK FORMER SITE FLOATING DREDGE	OSB099	0.89	Floodplain Waste Rock (Above Cataldo No.& So.Fork)					
TRAIL CK HYDRAULIC MINING AREA	OSB104	2.43	Floodplain Waste Rock (Above Cataldo No.& So.Fork)					
TRAIL CK IMPACTED FLOODPLAIN-PLCR/DRDG	OSB100	17.91	Floodplain Waste Rock (Above Cataldo No.& So.Fork)	SW	1			
TRAIL CK IMPACTED RIPARIAN	OSB107	0.49	Floodplain sediments (above Cataldo No.& So. Fork)					
TUSCUMBIA MINE	BUR033	0.80	Upland waste rock					
UNIDENTIFIED DISTURBANCE	BUR028	0.35						
UNNAMED ADIT	BUR037	0.50						
UNNAMED ADIT	BUR038	1.64						
UNNAMED ADIT	OSB050	0.10						
UNNAMED ADIT	OSB106	0.06						
UNNAMED PROSPECT	OSB021	1.46						
UNNAMED PROSPECT	OSB022	0.79						
UNNAMED PROSPECT	OSB023	0.84						
UNNAMED PROSPECTS	OSB018	0.52	Upland waste rock					
UNNAMED TUNNEL	OSB090	0.36	Upland waste rock					
UNNAMED TUNNEL	OSB109	0.15	Mine Workings/Water, Seeps, Springs and Leachate					
VIRGINIA MINE	BUR035	0.34	Upland waste rock					
WAKEUP JIM MINE	OSB105	0.11	Upland waste rock					

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.2-1
Mass Loading Beaver Creek

Location	Segment	Sample Type	Sample No.	Sample Date	Flow (CFS)	Flow Delta	Total Lead Conc. (µg/L)	Total Lead Mass Load (lbs/day)	Dissolved Zinc Conc. (µg/L)	Dissolved Zinc Mass Load (lbs/day)
BV11	1	RV	46295	11-May-98	4.6	-	4.4	-	1650	41
BV12	1	RV	46296	11-May-98	9.8	5.3	3.4	< 1	164	9
BV9	1	RV	46288	06-May-98	33.8	24.0	2.4		394	72
BV6	1	RV	46284	05-May-98	73.0	39.2	1.6	1	106	42
BV3	1	RV	46283	05-May-98	72.4	-0.6	0.9	< 1	62	24
BV1	1	RV	46281	05-May-98	85.6	13.2	0.7	< 1	-	-
BV1	1	RV	186822	24-May-99	141	-	4.42	3.36	59.4	45.2
Side Stream Sampling Locations										
BV10	1	SS	46297	11-May-98	0.2	-	0.2 U	-	417	< 1
BV8	1	SS	46293	11-May-98	1.6	-	0.2 U	-	10 U	-
BV7	1	SS	46287	06-May-98	5.6	-	0.5 U	-	5 U	-
BV5	1	SS	46286	06-May-98	1.3	-	0.5 U	-	5 U	-
BV4	1	SS	46285	06-May-98	3.9	-	0.5 U	-	5 U	-
Adits, Seeps and Pond Sampling										
BV8147	1	LK	187889	01-Jan-97	< 1	-	24	-	400	-
BV8149	1	AD	187891	01-Jan-97	< 1	-	26	-	6600	-
BV8151	1	AD	187893	01-Jan-97	< 1	-	14	-	2600	-
BV8246	1	AD	187988	01-Jan-97	< 1	-	15 U	-	2.5 U	-
BV8248	1	AD	187990	01-Jan-97	< 1	-	15 U	-	2.5 U	-
BV8249	1	AD	187991	01-Jan-97	< 1	-	15 U		2.5 U	-
BV8250	1	SP	187992	01-Jan-97	< 1	-	15 U		2.5 U	-

Notes:
- No Data or Loads Not Calculated
CFS - cubic feet per second
Flow Delta - difference in flow between this location and the nearest upstream location
µg/L - micrograms per liter
lbs/day - pounds per day
AD - adit sample
LK - lake or pond sample
RV - river sample
SP - seep sample
SS - samples collected in side stream off the main stream channel
U - not detected

5.0 FATE AND TRANSPORT

The fate and transport of metals in surface water and sediment in the Beaver Creek Watershed are discussed in this section. Groundwater data were not available for this watershed. A conceptual model of fate and transport, important fate and transport mechanisms, and a summary of the probabilistic model developed to evaluate fate and transport, were presented in the fate and transport section in the Canyon Creek report and are not repeated here. Due to limited available surface water data for the Beaver Creek Watershed, the probabilistic model was not used to estimate expected values for discharge, metals concentrations or mass loading. Instead, measured values for these parameters were evaluated, and results are presented in this section.

A qualitative discussion of initial findings on metals concentrations and mass loading for Beaver Creek, as presented above in Section 4, Nature and Extent, is briefly presented in Section 5.1. Section 5.2 is devoted to model results; however, as explained in this section, no probabilistic results are discussed. Sediment transport is summarized in Section 5.3. Summary tables of metal fate and transport in the Beaver Creek Watershed are presented in Section 5.4.

5.1 INTRODUCTION

The Beaver Creek Watershed contributes minor quantities of cadmium, lead, zinc, and other metals to the North Fork. The minimum and maximum detected values of dissolved and total zinc, lead, and cadmium concentrations for samples collected from in-stream locations are listed in Table 5-1 with the number of samples analyzed for each parameter. Potential sources of these metals in the watershed were identified in Section 4.1 and preliminary mass loading estimates were discussed in Section 4.2. Brief summaries of those results are included in Section 5.4.

5.2 MODEL RESULTS

No probabilistic modeling was conducted for Beaver Creek because of the paucity of data at individual sampling locations. Even though up to 27 individual sampling events occurred in the Beaver Creek Watershed, a maximum of two sampling events occurred at any individual location.

Typically, the criterion used for selecting sampling locations was that 10 or more sampling events had occurred at a given location. No sampling locations in Beaver Creek met this criterion, nor did they meet reduced criterion of 5 or more sampling events at a given location.

5.2.1 Estimated Discharge

Too few discharge data were available to address the lognormal distribution of discharge data at any of the sampling locations in Beaver Creek. Available discharge data are discussed in Section 2.3, Surface Water Hydrology.

5.2.2 Available Data

The entire Beaver Creek Watershed was assigned to one segment, segment BvrCrkSeg01. This segment has not been evaluated extensively. Mining and milling was done in the upper part of the Beaver Creek Watershed. Approximately 74 potential source areas were identified by the BLM in Beaver Creek, including the Carlisle Mill and Mine site. Concentrations of zinc exceeded 1,000 µg/L below the Carlisle Mill site but are substantially reduced in the lower part of Beaver Creek.

Concentrations of metals in water in the upper part of Beaver Creek are likely to cause harm to aquatic life, but do not contribute significantly to metals loading in the lower part of the Coeur d'Alene basin.

5.3 SEDIMENT FATE AND TRANSPORT

Sediment fate and transport processes were presented in Section 3. Results of the sediment transport evaluation presented in Section 3 are summarized in this section.

Sediment derived in Beaver Creek is transported to the North Fork. The Beaver Creek Watershed has a drainage area of approximately 44.1 square miles, with approximately 12 miles of mapped channel. Based on review of aerial photographs, potential sediment sources in Beaver Creek are mining wastes, mobilization of channel bed sediment, bank erosion, and rock debris and tailings piles situated adjacent to channels.

USGS sediment gaging data are not available for Beaver Creek; therefore, estimates of sediment yield are not included in this discussion. Suspended and bedload sediment samples were not collected and analyzed for metals. Insufficient data were collected on surface soil and sediment samples from which to estimate suspended and bedload sediment concentrations.

5.4 SUMMARY OF FATE AND TRANSPORT

Tables 5-1 and 5-2 summarize available data in Beaver Creek. Table 5-1 contains the minimum and maximum detected dissolved and total concentrations of zinc, lead, and cadmium in samples collected from in-stream locations. Maximum observed concentrations of total and dissolved zinc exceed the screening levels by almost two orders of magnitude. The maximum observed total and dissolved cadmium concentrations also exceeded screening levels. The maximum observed dissolved lead concentration also exceeded the screening level.

Instantaneous mass loadings are found in Table 5-2. Mass loading values were all less than total maximum daily loads (TMDLs) established for the North Fork at Enaville (USEPA 2000).

Table 5-1
Minimum and Maximum Detected[1] Concentrations of Dissolved and Total Zinc, Lead, and Cadmium

Metal (number of samples)	Minimum Value Detected (µg/L)	Maximum Value Detected (µg/L)	Screening Level (µg/L)
Dissolved Zinc	1.74	**2,700**	42
Total Zinc	1.75	**3,100**	30
Dissolved Lead	0.05	**2.4**	1.09
Total Lead	0.13	4.4	15
Dissolved Cadmium	0.08	**13**	0.38
Total Cadmium	0.05	**21**	2

[1] Includes data from samples with location type "RV" only. See Attachment 2.
Bold values exceed screening levels.
µg/L - micrograms per liter

Table 5-2
Low and High Instantaneous Metal Loading Values for Sampling Location BV1

Metal	Low (pounds/day)	High (pounds/day)
Total Lead	<1	3.36
Dissolved Zinc	NA	45.2

Note: NA - not available

6.0 REFERENCES

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Section 2.2—Hydrogeology

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Section 5—Fate and Transport

U.S. Environmental Protection Agency (USEPA). 2000. Total Maximum Daily Load for Dissolved Cadmium, Dissolved Lead, and Dissolved Zinc in Surface Water of the Coeur d'Alene Basin. Final Technical Support Document. USEPA Region 10. August 2000.

ATTACHMENT 1
Data Source References

Data Source References

Data Source References*	Data Source Name	Data Source Description	Reference
2	URS FSPA Nos. 1, 2, and 3	Fall 1997: Low Flow and Sediment Sampling	URS Greiner Inc. 1997. Field Sampling Plan Addendum 1 Sediment Coring in the Lower Coeur d'Alene River Basin, Including Lateral Lakes and River Floodplains
			URS Greiner Inc. 1997. Field Sampling Plan Addendum 2 Adit Drainage, Seep and Creek Surface Water Sampling
			URS Greiner Inc. 1997. Field Sampling Plan Addendum 3 Sediment Sampling Survey in the South Fork of the Coeur d'Alene River, Canyon Creek, and Nine-Mile Creek
3	URS FSPA No. 4	Spring 1998: High Flow Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 4 Adit Drainage, Seep and Creek Surface Water Sampling; Spring 1998 High Flow Event
4	MFG Historical Data Spring 1991	Spring 1991: High Flow Sampling	McCulley, Frick & Gillman, Inc. 1991. Upstream Surface Water Sampling Program Spring 1991 High Flow Event, South Fork Coeur d'Alene River Basin above Bunker Hill Superfund Site: Tables 1 and 2
5	MFG Historical Data Fall 1991	Fall 1991: Low Flow Sampling	McCulley, Frick & Gillman, Inc. 1992. Upstream Surface Water Sampling Program Fall 1991 Low Flow Event, South Fork Coeur d'Alene River Basin above Bunker Hill Superfund Site: Tables 1 and 2
6	EPA/Box Historical Data	Superfund Site Groundwater and Surface Water Data	CH2MHill. 1997. Location of Wells and Surface Water Sites, Bunker Hill Superfund Site. Fax Transmission of Map August 11, 1998
			Environmental Protection Agency. 1998. E-mail from Ben Cope July 15, 1998. Subject: 2 Datasets File Attached: BOXDATA.WK4
7	IDEQ Historical Data	IDEQ Water Quality Data	Idaho Department of Environmental Quality. 1998. Assortment of files from Glen Pettit for water years 1993 through 1996
			Idaho Department of Environmental Quality. 1998. E-mail from Glen Pettit October 6, 1998 Subject: DEQ Water Quality Data Files Attached: 1998 trend Samples.xls, 1997 trend Samples.xls

Data Source References (Continued)

Data Source References*	Data Source Name	Data Source Description	Reference
8	EPA/NPDES Historical Data	Water Quality based on NPDES Program	Environmental Protection Agency. 1998. E-mail from Ben Cope August 11, 1998/September 2, 1998. Subject: Better PCS Data Files/Smelterville. Attached: PCS2.WK4, PCSREQ.698/TMT-PLAN.XLS
			Environmental Protection Agency. 1998. E-mail from Ben Cope August 5, 1998. Subject: State of Idaho Lat/Longs File Attached: PAT.DBF
			Environmental Protection Agency. 1998. E-mail from Ben Cope July 15, 1998. Subject: 2 Datasets File Attached: PCSDATA.WK4
10	URS FSPA No. 5	Common Use Areas Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 5 Common Use Areas: Upland Common Use Areas and Lower Basin Recreational Beaches; Sediment/Soil, Surface Water, and Drinking Water Supply Characterization
11	URS FSPA No. 8	Source Area Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 8 Tier 2 Source Area Characterization Field Sampling Plan
12	Historical Groundwater Data from MFG	1997 Annual Groundwater Data Report Woodland Park	McCulley, Frick & Gillman. 1998. 1997 Annual Groundwater Data Report Woodland Park
13	Historical Data from US Forest Service, Idaho Geological Survey and others	Historical Data on Inactive Mine Sites USFS, IGS and CCJM, 1994-1997, Prichard Creek, Pine Creek and Summit Mining District	Mackey K, Yarbrough, S.L. 1995. Draft Removal Preliminary Assessment Report Pine Creek Millsites, Coeur d'Alene District, Idaho, Contract No. 1422-N651-C4-3049
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. I, Prichard Creek and Eagle Creek Drainages
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. III, Coeur d'Alene River Drainage Surrounding the Coeur d'Alene Mining District (Excluding the Prichard Creek and Eagle Creek Drainages)
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. IV, Prichard Creek and Eagle Creek Drainages

Data Source References (Continued)

Data Source References*	Data Source Name	Data Source Description	Reference
13	Historical Data from US Forest Service, Idaho Geological Survey and others (continued)		Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. V, Coeur d'Alene River Drainage Surrounding the Coeur d'Alene Mining District (Excluding the Prichard Creek and Eagle Creek Drainages) Part 2 Secondary Properties
			US Forest Service. 1995. Pilot Inventory of Inactive and Abandoned Mine Lands, East Fork Pine Creek Watershed, Shoshone County, Idaho
14	Historical Sediment Core Data: University of Idaho (Thesis papers)	Historical Lateral Lakes Sediment Data from F. Rabbi and M.L. Hoffman	Characterization of Heavy Metal Contamination in Two Lateral Lakes of the Lower Coeur d'Alene River Valley, A thesis by M.L. Hoffmann, May 1995
			Trace Element Geochemistry of Bottom Sediments and Waters from the Lateral Lakes of Coeur d'Alene River, A Dissertation by F. Rabbi, May 1994
15	URS FSPA No. 9	Source Area Characterization; Field XRF Data	CH2M Hill and URS Greiner. 1998. Field Sampling Plan Addendum 9 Delineation of Contaminant Source Areas in the Coeur d'Alene Basin using Survey and Hyperspectral Imaging Techniques
16	Historical Sediment Data	Electronic Data compiled by USGS	U.S. Geological Survey. 1992. Effect of Mining-Related Activities on the Sediment-Trace Element Geochemistry of Lake Coeue d'Alene, Idaho, USA--Part 1: Surface Sediments, USGS Open-File Report 92-109, Prepared by A.J. Horowitz, K.A. Elrick, and R.B. Cook
			US Geological Survey. 2000. Chemical Analyses of Metal-Enriched Sediments, Coeur d'Alene Drainage Basin, Idaho: Sampling, Analytical Methods, and Results. Draft. October 13, 2000. Prepared by S.E. Box, A.A. Bookstrom, M. Ikramuddin, and J. Lindsey. Samples collected from 1993 to 1998.
17	USGS Spokane River Basin Sediment Samples	Surface Sediment Samples Collected by USGS in the Spokane River Basin	Environmental Protection Agency. 1999. Data Validation Memorandum and Attached Table from Laura Castrilli to Mary Jane Nearman dated June 9, 1999. Subject: Coeur d'Alene (Bunker Hill) Spokane River Basin Surface Sample Samples, USGS Metals Analysis, <63 um fraction, Data Validation, Samples SRH7-SRH30

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
18	USGS Snomelt Surface Water Data	Surface Water Data from 1999 Snomelt Runoff Hydrograph	USGS. 1999. USGS WY99.xls Spreadsheet dowloaded from USGS (Coeur d'Alene Office) ftp site
			USGS. 2000. Concentrations and Loads of Cadmium, Lead and Zinc Measured near the Peak of the 1999 Snomelt Runoff Hydrograph at 42 Stations, Coeur d'Alene River Basin Idaho
			USGS. 2000. Concentrations and Loads of Cadmium, Lead and Zinc Measured on the Ascending and Descending Limbs of the 1999 Snomelt Runoff Hydrograph at Nine Stations, Coeur d'Alene River Basin Idaho
22	MFG Report on Union Pacific Railroad Right-of-Way Soil Sampling	Surface and Subsurface Soil Lead Data	MFG. 1997. Union Pacific Railroad Wallace Branch, Rails to Trails Conversion, Right-of-Way Soil Sampling, Summary and Interpretation of Data. McCulley, Frick and Gilman, Inc. March 14, 1997
23	URS FSPA No. 11A	Source Area Groundwater and Surface Water Sampling	URS Greiner Inc. 1999. Field Sampling Plan Addendum 11A Tier 2 Source Area Characterization
24	URS FSPA No. 15	Common Use Area Sampling—Spokane River	URS Greiner Inc. 1999. Field Sampling Plan Addendum 15 Spokane River - Washington State Common Use Area Sediment Characterization
25	URS FSPA No. 18	Depositional and Common Use Area Sediment Sampling - Spokane River	URS Greiner Inc. 2001. Final Field Sampling Plan Addendum No. 18, Fall 2000 Field Screening of Sediment in Spokane River Depositional Areas, Summary of Results. Revision 1. January 2001.
28	USGS National Water Quality Assessment database	Surface water data for sampling location NF50 at Enaville, Idaho.	USGS. 2001. USGS National Water Quality Assessment database: http://infotrek.er.usgs.gov/pls/nawqa/nawqa.wwv_main.gohome. Data retrieved on August 2, 2001 for station 12413000, NF Coeur d'Alene River at Enaville, Idaho.

[a]Reference Number is the sequential number used as cross reference to associate chemical results in data summary tables with specific data collection efforts.

ATTACHMENT 2

Data Summary Tables

ABBREVIATIONS USED IN DATA SUMMARY TABLE

LOCATION TYPES:

AD adit
BH borehole
FP flood plain
GS ground surface/near surface
HA hand auger boring
LK lake/pond/open reservoir
OF outfall/discharge
RV river/stream
SP stockpile
TL tailings pile

QUALIFIERS:

U Analyte was not detected above the reported detection limit
J Estimated concentration

DATA SOURCE REFERENCES:

Data source references listed in Attachment 1 are shown in the data summary tables in the "Ref" column.

Data Summary Table
Beaver Creek - segment BvrCrkSeg01

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Soil (mg/kg)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
BV8168	TL	13	---			250	6.6	250	37000	* 64000	36			1800
BV8177	TL	13	---			94	2.5	45	43000	3000	740			250
BV8178	TL	13	---			110	4.9	130	29000	1100	1400			1200
BV8179	TL	13	---			82	2.4	64	34000	920	1100			200
BV8180	TL	13	---			99	3.5	59	49000	630	1600			160
BV8181	TL	13	---			170	8.1	97	146000	7600	2800			1100
BV8182	TL	13	---			130	15	90	43000	2100	1200			3800
BV8284	TL	13	---			85 U	1.5	84	11000	1600	1300			150
BV8286	TL	13	---			85 U	1.9	28	16000	74	490			140
BV8287	TL	13	---			130	4.6	51	27000	230	1100			540

Surface Water - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
BV1	RV	18	05/24/1999						200	4	11			70
BV1	RV	3	05/05/1998		0.2 U	2 U		2 U	41	0.7	5 U	0.2 U	0.2 U	48
BV1	RV	3	05/05/1998				0.3							
BV10	RV	3	05/11/1998		0.2 U	2 U	1.5	2 U	38	0.2 U	5 U	0.2 U	0.2 U	427
BV11	RV	3	05/11/1998		0.2 U	2 U	6.2	2 U	20 U	4.4	5 U	0.2 U	0.2 U	1610
BV12	RV	3	05/11/1998		0.2 U	2 U	0.9	2 U	20 U	3.4	5 U	0.2 U	0.2 U	167
BV13	RV	15	08/17/1999	0	0.21	0.2 U	0.07	1.97 J	19.1 J	1.24	1.4 J	0.1 U	2 U	5.29 J
BV14	RV	15	08/17/1999	0		0.3 J		1.1 U	28.1 J		1.12 J	0.1 U	2 U	1.75 J
BV14	RV	15	08/17/1999	0	0.24		0.05 J			0.13				
BV3	RV	3	05/05/1998		0.2 U	2 U	0.4	2 U	51	0.9	5 U	0.2 U	0.2 U	67
BV4	RV	3	05/06/1998		0.5 U	1 U	0.1 U	3 U	47 U	0.5 U	5 U	0.2 U	0.3 U	5 U
BV5	RV	3	05/06/1998		0.5 U	1 U	0.1 U	3 U	32.1 U	0.5 U	5 U	0.2 U	0.3 U	5 U
BV6	RV	3	05/05/1998		0.2 U	2 U	0.5	2 U	60	1.6	5 U	0.2 U	0.2 U	106
BV7	RV	3	05/06/1998		0.5 U	1.6	0.1 U	3 U	51.9 U	0.5 U	5 U	0.2 U	0.3 U	5 U
BV8	RV	3	05/11/1998			2 U	0.2 U	2 U	20 U	0.2 U	5 U	0.2 U	0.2 U	10 U
BV8	RV	3	05/11/1998		0.5									
BV8147	LK	13	---			29 U	9	36	2600	24	66	5 U		540
BV8148	RV	13	---			29 U	21	35 U	12 U	2.5	8	5 U		* 3100
BV8149	AD	13	---			29 U	33	35 U	12 U	26	96	5 U		* 7400
BV8150	RV	13	---			29 U	7	35 U	22	15 U	4	5 U		490
BV8151	AD	13	---			29 U	17	35 U	500	14	140	5 U		* 3200
BV8152	RV	13	---			29 U	3 U	35 U	12 U	15 U	4	5 U		6
BV8153	RV	13	---			29 U	3 U	35 U	34	15 U	3	5 U		740
BV8246	AD	13	---			29 U	3 U	35 U	1000	15 U	87	5 U		22

Data Summary Table
Beaver Creek - segment BvrCrkSeg01

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
BV8247	RV	13	—			0.6	6	35 U	12 U	15 U	3	5 U		3 U
BV8248	AD	13	—			29 U	16	35 U	43	15 U	13	5 U		14
BV8249	AD	13	—			29 U	6	35 U	12 U	15 U	4	5 U		3
BV8250	SP	13	—			29 U	5	35 U	12 U	15 U	14	5 U		24
BV8264	RV	13	—			29 U	3	35 U	12 U	15 U	2	5 U		3 U
BV9	RV	3	05/06/1998		0.5 U	1 U	1.8	3 U	20 U	2.4	5 U	0.2 U	0.3 U	393
Surface Water - Dissolved Metals (ug/l)														
BV1	RV	18	05/24/1999				1 U		10 U	1 U	1.6			59
BV1	RV	3	05/05/1998		0.2 U	2 U		2 U	20 U	0.3	5 U	0.2 U	0.2 U	
BV1	RV	3	05/05/1998				0.3							52
BV10	RV	3	05/11/1998		0.2 U	2 U	1.3	2 U	20 U	0.2 U	5 U	0.2 U	0.2 U	417
BV11	RV	3	05/11/1998		0.2 U	2 U	6	2 U	20 U	3	5 U	0.2 U	0.2 U	1650
BV12	RV	3	05/11/1998		0.2 U	2 U	0.8	2 U	20 U	2.4	5 U	0.2 U	0.2 U	164
BV13	RV	15	08/17/1999	0	0.19	0.2 U	0.04 J	1.1 U	4.52 J	0.31	0.8 U	0.1 U	2 U	5.29 J
BV14	RV	15	08/17/1999	0		0.3 J		1.1 U			0.8 U	0.11 J	2 U	1.74 J
BV14	RV	15	08/17/1999	0	0.22		0.08		7.03 J	0.05				
BV3	RV	3	05/05/1998		0.2 U	2 U	0.4	2 U	20 U	0.3	5 U	0.2 U	0.2 U	62
BV4	RV	3	05/06/1998		0.5 U	1 U	0.1 U	3 U	20 U	0.5 U	5 U	0.2 U	0.3 U	5 U
BV5	RV	3	05/06/1998		0.5 U	1 U	0.1 U	3 U	20 U	0.5 U	5 U	0.2 U	0.3 U	5 U
BV6	RV	3	05/05/1998		0.2 U	2 U	0.5	2 U	20 U	0.3	5 U	0.2 U	0.2 U	106
BV7	RV	3	05/06/1998		0.5 U	1.6	0.1 U	3 U	20 U	0.5 U	5 U	0.2 U	0.3 U	5 U
BV8	RV	3	05/11/1998			2 U	0.2 U	2 U	20 U	0.2 U	5 U	0.2 U	0.2 U	10 U
BV8	RV	3	05/11/1998		0.5									
BV8147	LK	13	—				3.7	8.4 U	7.8		33			400
BV8148	RV	13	—				13	8.4 U	3.7 U		9.2			2700
BV8149	AD	13	—				26	8.4	3.7 U		96			* 6600
BV8150	RV	13	—				3.4	8.4 U	3.7 U		5.9			360
BV8151	AD	13	—				10	12	3.7 U		130			2600
BV8152	RV	13	—				2.3 U	8.4 U	3.7 U		3			2.5 U
BV8153	RV	13	—				3	8.4 U	3.7 U		3.4			540
BV8246	AD	13	—				5.2	8 U	16		69			2.5 U
BV8247	RV	13	—				3.1	3.1	3.7 U		2			2.5 U
BV8248	AD	13	—				8	8 U	3.7 U		6			2.5 U
BV8249	AD	13	—				4.2	8 U	8.4		5			2.5 U
BV8250	SP	13	—				2.4	8 U	3.7 U		8			2.5 U
BV9	RV	3	05/06/1998		0.5 U	1 U	1.7	3 U	20 U	1.1	5 U	0.2 U	0.3 U	394

ATTACHMENT 3
Statistical Summary Tables for Metal

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment BvrCrkSeg01
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Arsenic	10	8	82	250	133	0.41	22	8	1	0
Cadmium	10	10	1.5	15	5.1	0.8	9.8	1	0	0
Copper	10	10	28	250	89.8	0.71	100	2	0	0
Iron	10	10	11,000	146,000	43,500	0.87	65,000	1	0	0
Lead	10	10	74	64,000	8,130	2.44	171	9	4	1
Manganese	10	10	36	2,800	1,180	0.62	3,597	0	0	0
Zinc	10	10	140	3,800	934	1.24	280	5	1	0

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment BvrCrkSeg01
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	13	3	0.19	0.5	0.303	0.56	2.92	0	0	0
Arsenic	13	2	0.3	1.6	0.95	0.97	150	0	0	0
Cadmium	26	20	0.04	26	4.66	1.31	0.38	17	7	0
Copper	25	3	3.1	12	7.83	0.57	3.2	2	0	0
Iron	26	5	4.52	16	8.75	0.49	1,000	0	0	0
Lead	14	8	0.05	3	0.97	1.15	1.09	3	0	0
Manganese	26	13	1.6	130	28.6	1.48	20.4	4	0	0
Mercury	13	1	0.11	0.11	0.11	< 0.001	0.77	0	0	0
Zinc	26	16	1.74	6,600	1,010	1.71	42	14	5	1

Statistical Summary of Total Metals Concentrations in Surface Water
Segment BvrCrkSeg01
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	13	3	0.21	0.5	0.317	0.5	6	0	0	0
Arsenic	26	3	0.3	1.6	0.833	0.82	50	0	0	0
Cadmium	26	19	0.05	33	7.09	1.24	2	11	2	0
Copper	26	2	1.97	36	19	1.27	1	2	1	0
Iron	27	13	19.1	2,600	357	2.05	300	3	0	0
Lead	27	13	0.13	26	6.56	1.36	15	2	0	0
Manganese	27	16	1.12	140	28.6	1.52	50	4	0	0
Zinc	27	21	1.75	7,400	878	2.02	30	14	9	3

ATTACHMENT 4
Screening Levels

SCREENING LEVELS

Based on the results of the human health and ecological risk assessments, 10 chemicals of potential concern (COPCs) were identified for inclusion and evaluation in the RI. The COPCs and appropriate corresponding media (soil, sediment, groundwater, and surface water) are summarized in Table 1. For each of the COPCs listed in Table 1, a screening level was selected.

The screening levels were used in the RI to help identify source areas and media of concern that would be carried forward for evaluation in the feasibility study (FS). The following paragraphs discuss the rationale for the selection of the screening levels.

Applicable risk-based screening levels and background concentrations were compiled from available federal numeric criteria (e.g., National Ambient Water Quality Criteria), regional preliminary remediation goals (PRGs) (e.g., EPA Region IX PRGs), regional background studies for soil, sediment, and surface water, and other guidance documents (e.g., National Oceanographic and Atmospheric Administration freshwater sediment screening values). Selected RI screening levels are listed in Tables 2 through 4.

For the evaluation of site soil, sediment, groundwater, and surface water chemical data, the lowest available risk-based screening level for each media was selected as the screening level. If the lowest risk-based screening level was lower than the available background concentration, the background concentration was selected as the screening level.

Groundwater data are screened against surface water screening levels to evaluate the potential for impacts to surface water from groundwater discharge.

For site groundwater and surface water, total and dissolved metals data are evaluated separately. Risk-based screening levels for protection of human health (consumption of water) are based on total metals results, therefore, total metals data for site groundwater and surface water were evaluated against screening levels selected from human health risk-based screening levels. Risk-based screening levels for protection of aquatic life are based on dissolved metals results, therefore, dissolved metals data for site groundwater and surface water were evaluated against screening levels selected from aquatic life risk-based screening levels.

Table 1
Chemicals of Potential Concern

Chemical	Human Health COPC			Ecological COPC		
	Soil/Sediment	Groundwater	Surface Water	Soil	Sediment	Surface Water
Antimony	X	X				
Arsenic	X	X	X	X	X	
Cadmium	X	X	X	X	X	X
Copper				X	X	X
Iron	X					
Lead	X	X	X	X	X	X
Manganese	X		X			
Mercury			X		X	
Silver					X	
Zinc	X	X	X	X	X	X

Table 2
Selected Screening Levels for Groundwater and Surface Water—Coeur d'Alene River Basin and Coeur d'Alene Lake

Chemical	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Groundwater Total (µg/L)	Groundwater Dissolved (µg/L)
Antimony	6[a]	2.92[b]	6[a]	2.92[b]
Arsenic	50[a]	150[c,d]	50[a]	150[c,d]
Cadmium	2[e]	0.38[b]	2[e]	0.38[b]
Copper	1[e]	3.2[c,d]	1[e]	3.2[c,d]
Iron	300[a]	1,000[c,d]	300[a]	1,000[c,d]
Lead	15[a]	1.09[b]	15[a]	1.09[b]
Manganese	50[a]	20.4[b]	50[a]	20.4[b]
Mercury	2[a]	0.77[c,d]	2[a]	0.77[c,d]
Silver	100[a]	0.43[c,d]	100[a]	0.43[c,d]
Zinc	30[e]	42[c,d]	30[e]	42[c,d]

[a]40 CFR 141 and 143. National Primary and Secondary Drinking Water Regulations. U.S. EPA Office of Water. Office of Groundwater and Drinking Water. http://www.epa.gov/OGWDW/wot/appa.html. October 18, 1999.
[b]Dissolved surface water 95th percentile background concentrations calculated from URS project database.
[c]Freshwater NAWQC for protection of aquatic life are expressed in terms of the dissolved metal in the water column.
[d]Freshwater NAWQC for cadmium, copper, lead, silver, and zinc are expressed as a function of hardness (mg/L of CaCO3) in the water column.
Values above correspond to a hardness value of 30 mg/L.
[e]Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of
Energy. Office of Environmental Management. ES/ER/TM-96/R2. Value based on total metals concentration.

Note:
µg/L - microgram per liter

Table 3
Selected Screening Levels for Surface Water—Spokane River Basin

Chemical	SpokaneRSeg01		SpokaneRSeg02		SpokaneRSeg03	
	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)
Antimony	6[a]	2.92[b]	6[a]	2.92[b]	6[a]	2.92[b]
Arsenic	50[a]	150[c]	50[a]	150[c]	50[a]	150[c]
Cadmium	2[e]	0.38[b]	2[e]	0.38[b]	2[e]	0.38[b]
Copper	1[e]	2.3[c,d]	1[e]	3.8[c,d]	1[e]	5.7[c,d]
Iron	300[a]	1,000[c]	300[a]	1,000[c]	300[a]	1,000[c]
Lead	15[a]	1.09[b]	15[a]	1.09[b]	15[a]	1.4[c,d]
Manganese	50[a]	20.4[b]	50[a]	20.4[b]	50[a]	20.4[b]
Mercury	2[a]	0.77[c]	2[a]	0.77[c]	2[a]	0.77[c]
Silver	100[a]	0.22[c,d]	100[a]	0.62[c,d]	100[a]	1.4[c,d]
Zinc	30[e]	30[c,d]	30[e]	50[c,d]	30[e]	75[c,d]

[a]40 CFR 141 and 143. National Primary and Secondary Drinking Water Regulations. U.S. EPA Office of Water. Office of Groundwater and Drinking Water. http://www.epa.gov/OGWDW/wot/appa.html. October 18, 1999.
[b]Dissolved surface water 95th percentile background concentrations calculated from URS project database. Technical Memorandum. Estimation of Background Concentration in Soils, Sediments, and Surface Waters. Coeur d'Alene Basin RI/FS. URS. May 2001.
[c]Freshwater NAWQC for protection of aquatic life are expressed in terms of the dissolved metal in the water column.
[d]Freshwater NAWQC for cadmium, copper, lead, silver, and zinc are expressed as a function of hardness (mg/L of $CaCO_3$) in the water column.
[e]Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of Energy. Office of Environmental Management. ES/ER/TM-96/R2. Value based on total metals concentration.

Note:
µg/L - microgram per liter

Table 4
Selected Screening Levels—Soil and Sediment

Chemical	Upper Coeur d'Alene River Basin		Lower Coeur d'Alene River Basin		Spokane River Basin	
	Soil (mg/kg)	Sediment (mg/kg)	Soil (mg/kg)	Sediment (mg/kg)	Soil (mg/kg)	Sediment (mg/kg)
Antimony	31.3[a]	3.30[b]	31.3[a]	3[c]	31.3[a]	3[c]
Arsenic	22[b]	13.6[b]	12.6[b]	12.6[b]	9.34[b]	9.34[b]
Cadmium	9.8[d]	1.56[b]	9.8[d]	0.678[b]	9.8[d]	0.72[b]
Copper	100[d]	32.3[b]	100[d]	28[c]	100[d]	28[c]
Iron	65,000[b]	40,000[c]	27,600[b]	40,000[c]	25,000[b]	40,000[c]
Lead	171[b]	51.5[b]	47.3[b]	47.3[b]	14.9[b]	14.9[b]
Manganese	3,597[b]	1,210[b]	1,760[a]	630[c]	1,760[a]	663[b]
Mercury	23.5[a]	0.179[b]	23.5[a]	0.179[b]	23.5[a]	0.174[c]
Silver	391[a]	4.5[c]	391[a]	4.5[c]	391[a]	4.5[c]
Zinc	280[b]	200[b]	97.1[b]	97.1[b]	66.4[b]	66.4[b]

[a]U.S. EPA Region IX Preliminary Remediation Goals for Residential or Industrial Soil http://www.epa.gov/region09/wasate/sfund/prg. February 3, 2000.
[b]Technical Memorandum. Estimation of Background Concentration in Soils, Sediments, and Surface Waters. Coeur d'Alene Basin RI/FS. URS. May 2001.
[c]Values as presented in National Oceanographic and Atmospheric Administration Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA. M. F. Buchman, 1999. Values generated from numerous reference documents.
[d]Final Ecological Risk Assessment. Coeur d'Alene Basin RI/FS. Prepared by CH2M HILL/URS for EPA Region 10. May 18, 2001. Values are the lowest of the NOAEL-based PRGs for terrestrial biota (Table ES-3).

Note:
mg/kg - milligram per kilogram

CSM Unit 1, Upper Watersheds

Big Creek

CONTENTS

CONTENTS (Continued)

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FIGURES

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ABBREVIATIONS AND ACRONYMS

AWQC	ambient water quality criteria
BigCrkSeg	Big Creek segment
BLM	Bureau of Land Management
cfs	cubic foot per second
CSM	conceptual site model
EPA	U.S. Environmental Protection Agency
FIS	flood insurance study
FIS	federal insurance study
FS	feasibility study
in	inch
IDEQ	Idaho Department of Environmental Quality
MFG	McCulley, Frick & Gilman, Inc.
μg/L	microgram per liter
NOAA	National Oceanic and Atmospheric Administration
PRG	preliminary remediation goal
RAC	Remedial Action Contract
redox	oxidation-reduction
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
SL	screening level
South Fork	South Fork Coeur d'Alene River
URS	URS Corporation
URSG	URS Greiner, Inc.
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WRCC	Western Regional Climate Center

1.0 INTRODUCTION

The Big Creek Watershed is located within the Coeur d'Alene River basin and is a north-flowing tributary of the South Fork Coeur d'Alene River (South Fork). The Bureau of Land Management (BLM) has identified 71 source areas (e.g., mining waste rock dumps, adits, and jig tailings piles) within the watershed (BLM 1999). The watershed has been affected by mining activities, and past and continuing releases of metals from mining wastes.

There have been no known major cleanup activities in the Big Creek watershed. During the 2000 field season, the USDA-Forest Service performed some minor grading to stabilize an access road around the waste rock dump at the Idaho-Leadville mine site; they have also performed several isolated portal closures (Johnson, 2000).

This watershed is one of eight watersheds assigned to conceptual site model (CSM) Unit 1, Upper Watersheds (see Part 1, Section 2, Conceptual Site Model Summary). The watershed itself has been divided into four segments to focus this investigation (Figure 1.1-1). Brief descriptions of each segment are presented in this section.

1.1 SEGMENT DESCRIPTIONS

Segment BigCrkSeg01 contains the headwaters of Big Creek down to just below the First National mine (Figure 4.1-1). The BLM identified nine source areas in this segment. Sampling of surface water indicates that metals concentrations are greater than ambient water quality criteria (AWQC).

Segment BigCrkSeg02 contains the headwaters of the East Fork of Big Creek (East Fork) to its confluence with the main stem of Big Creek (Figure 4.1-3). The BLM identified 21 source areas in this segment. These areas are mostly unnamed prospects in areas distant from the stream. Sampling of surface water indicates that metals concentrations in surface water are greater than AWQC.

Segment BigCrkSeg03 contains the headwaters of the West Fork of Big Creek (West Fork) down to its confluence with the main stem of Big Creek (Figure 4.1-4). The BLM identified eight source areas in this segment. Sampling of surface water indicates that metals concentrations in surface water are greater than AWQC.

Segment BigCrkSeg04 begins at the confluence of the main stem of Big Creek with the East Fork and ends at the confluence of Big Creek with the South Fork Coeur d'Alene River (Figure 4.1-6). The BLM identified 33 source areas in this segment. Sampling of surface water indicates that metals concentrations in surface water are greater than AWQC. Active mining operations associated with the Sunshine mine and mill complex have impacted riparian and riverine habitats. Impacts include loss of riparian vegetation and channel structure. The confluence of Big Creek with the South Fork Coeur d'Alene River has been recently restructured to allow the passage of fish between the two waterbodies. Fish populations in the watershed are comparable to those observed in reference streams and other less heavily modified watersheds throughout the basin; however, fish (trout and sculpin) were more prevalent in the upper portions of the watershed than in this segment which has a higher degree of anthropogenic impacts.

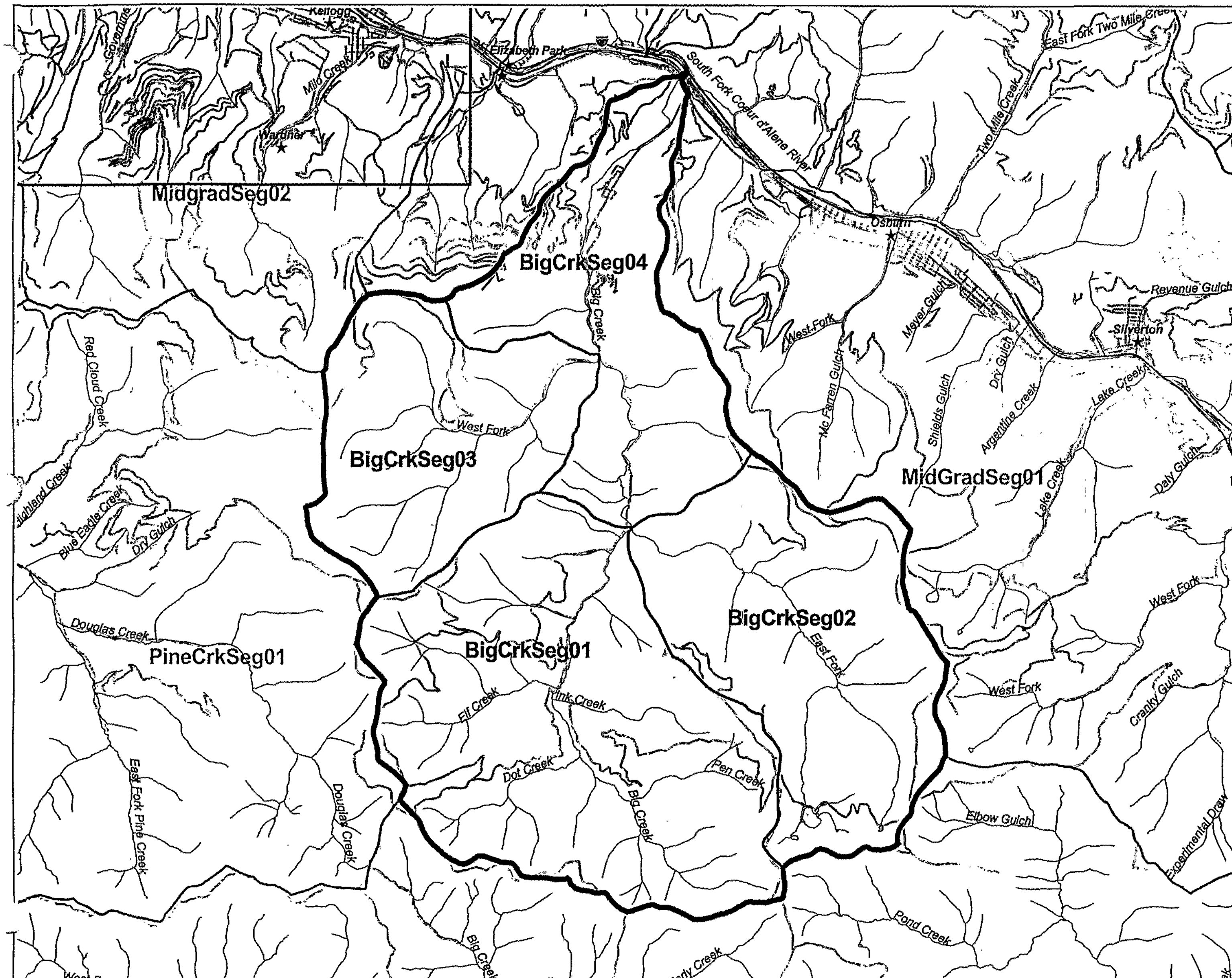
1.2 REPORT ORGANIZATION

The remedial investigation (RI) report is divided into seven parts. This report on the Big Creek Watershed is one of eight reports contained within Part 2 presenting the RI results for the eight CSM Unit 1 upper watersheds. The content and organization of this report are based on EPA's Guidance Document for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final (USEPA 1988). This report contains the following sections:

- Section 2–Physical Setting, includes discussions on the watershed's geology, hydrogeology, and surface water hydrology.
- Section 3–Sediment Transport Processes
- Section 4–Nature and Extent of Contamination, includes a summary of chemical results and estimates of mass loading from source areas
- Section 5–Fate and Transport, includes chemical and physical transport processes for metals
- Section 6–References

Risk evaluations and potential remedial actions associated with source and depositional areas are described in the human health risk assessment, the ecological risk assessment, and the feasibility study (FS) (all under separate cover).

Figure 1.1-1
Big Creek Watershed



LEGEND

- Stream
- Road
- Interstate 90
- City
- Big Creek Segment Watershed
- Big Creek Segment
- River Segment
- Lake/River
- Bunker Hill Box

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

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E: Big Creek
L: Final RI Big Creek
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This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983.

Date of Plot: July 13, 2001

2.0 PHYSICAL SETTING

2.1 GEOLOGY

2.1.1 Geomorphic Setting

The Big Creek Watershed is located on the south side of the South Fork Coeur d'Alene River (South Fork), about 3 miles east of Kellogg (Figure 1.1-1). Big Creek, West Fork Big Creek, and East Fork Big Creek are the principal drainages of the watershed (Figure 1.1-1). The headwaters of West Fork Big Creek and East Fork Big Creek begin in the St. Joe Mountains at an elevation of between 5,000 to 5,900 feet. West Fork Big Creek and East Fork Big Creek flow in a northerly direction and meet to form Big Creek (Part 1, Figure 1.2-2).

Like most drainages in the district, East Fork Big Creek, West Fork Big Creek, and Big Creek all flow through narrow, steep-walled, V-shaped canyons throughout their course, with the exception of the lower 2-mile-long reach of Big Creek above the confluence with the South Fork. The Big Creek channel widens along this 2-mile reach as the channel approaches the South Fork, displaying a relatively flat floodplain ranging from 0.1 to 0.3 mile wide that is enclosed by steep canyon walls.

2.1.2 Bedrock Geology

Weakly metamorphosed sedimentary rocks assigned to the Precambrian Belt Supergroup are the most prevalent rocks within the Big Creek Watershed (Part 1, Figure 3.2-1). West Fork Big Creek and East Fork Big Creek drain the Wallace Formation and a relatively minor amount of the Striped Peak Formation. The Wallace Formation consists of alternating beds of carbonate-bearing argillite and quartzite (Hobbs et al. 1965). The Striped Peak Formation consists of quartzite and lesser argillite (Hobbs et al. 1965).

2.1.3 Structural Geology

Roughly east-west-trending faults dominate the structural fabric of the Big Creek Watershed. The Osburn Fault is the principal structure of the district, and the most prominent faults mimic the trend of the Osburn Fault (Part 1, Figure 3.2-1). The most prominent faults in Big Creek are the Polaris (a normal fault), Silver Summit (type not determined), Alhambra (reverse fault), Big Creek (reverse fault), Placer Creek (normal fault), and Striped Peak (type not determined) (Part 1, Figures 3.2-1 and 3.2-2).

Parallel to the trend of the east-west-trending faults are two prominent anticlinal folds, designated the East Fork Anticline and the Big Creek Anticline (Hobbs et al. 1965). The fold axis of the Big Creek Anticline is between the Alhambra and Big Creek Faults. The fold axis of the East Fork Anticline is located within 1 mile and south of the Placer Creek Fault (Hobbs et al. 1965).

2.1.4 Soils

Like most of the soils throughout the district, the soils of the Big Creek Watershed can be grouped into two broad categories: hillside soils and valley soils. Hillside soils typically consist of silty loam with variable amounts of gravels and clay, generally less than 2 feet thick (MFG 1992; Camp Dresser & McKee 1986). Valley soils are primarily found within and along the flanks of the lower reaches of Big Creek and (to a lesser extent) at a point roughly midway between the headwaters of West Fork Big Creek and its confluence with Big Creek (Part 1, Figure 3.2-1). The valley soils are mapped as Quaternary alluvium (Part 1, Figure 3.2-1, symbol Qal). In the Big Creek Watershed, Quaternary alluvial deposits are a mixture of cobbly gravels, sands, and silts. There are more cobbly gravels than sands in the West Fork Big Creek Qal deposits and upper reaches of Big Creek, whereas sands predominate in the 2-mile-long reach of Big Creek above the confluence with the South Fork (Part 1, Figure 3.2-1).

West and east of the 2-mile-long reach of Big Creek above the confluence with the South Fork are Quaternary terrace gravels, which are characterized by well-developed sandy soil overlying cobbly to bouldery gravels (Part 1, Figure 3.2-1, symbol QTog) (Box, Bookstrom, and Kelley 1999). These deposits exist as benches up to 1,200 feet topographically above nearby streams (Umpleby and Jones 1923).

Included with the Quaternary alluvium are tailings and related materials produced by mining activities. Tailings are discussed further in Section 4, Nature and Extent of Contamination.

Metal concentrations in soil may be elevated in areas underlain by very shallow mineralization or ore deposits. These elevated areas of metal concentrations, or dispersion patterns, were studied in the basin by the USGS (Gott and Cathrall 1980). In Part 1 of the RI, the determination of background takes into account such effects.

2.1.5 Ore Deposits

The Big Creek Watershed drains a portion of the Page-Galena Mineral Belt; part of this belt is referred to as the Silver Belt (Part 1, Figure 3.2-3). Silver was the most abundant metal produced the Big Creek Watershed. The dominant ore deposit type consists of what is referred to as fissure vein deposits, which are steeply dipping veins hosted primarily by the Revett-St. Regis Formations transition zone (Stratus 1999). This transition zone is several hundred feet thick and is characterized by increasingly less pure quartzite grading into impure quartzite and interbedded argillite (Hobbs et al. 1965). Fissure veins are typically fault-controlled, and the veins at the Crescent and Sunshine Mines occur within the Alhambra Fault (Part 1, Figure 3.2-3).

The principal ore minerals are galena (lead), tetrahedrite (silver and copper), sphalerite (zinc), and chalcopyrite (copper). The principal non-ore minerals associated with the fissure vein deposits are quartz, pyrite, siderite (an iron carbonate), ankerite (a calcium-iron carbonate) and minor arsenopyrite (an iron-arsenic sulfide). Zonation of certain minerals is present within the deposits. In the Crescent and Sunshine Mines, the relative volume of tetrahedrite increases with depth, whereas the relative volume of galena decreases with depth (White 1998). Pyrite and chalcopyrite also increase with depth (White 1998).

Waste rock piles are present at all mine workings and consist of broken, angular rock that is generally unmilled and typically dumped near the mouth of workings. The chemical and mineralogical content of waste rock in the Big Creek Watershed is discussed further in Section 4, Nature and Extent of Contamination.

2.1.6 Mining History

A brief summary of available information on historical mining activities is presented in this section. During the RI/FS process, an extensive list of mines, mills, and other source areas was developed based on a list originally developed by the Bureau of Land Management (BLM 1999). This list is presented in Section 4.1, Nature and Extent, and in Appendix I.

Mining began in the Big Creek basin by at least 1884. During that year, True and Dennis Blake discovered the Yankee lode on the south side of the South Fork. The Blakes hand picked ores from tiny stringers and at times hand jigged their product prior to shipping. These methods continued until at least 1914 when the Blakes gave up their mining activities to leasers. On-site processing of ores by these methods resulted in coarse jigs tailings, which were very high in metal content, being discharged to Big Creek (Quivik 1999). Hand sorting and jigging of ore may have continued under lease operations after 1914.

A mill was not associated with the Yankee Boy and Yankee Girl Mines until the mines were acquired by the newly organized Sunshine Mining Company in December 1920. By this time, the Big Creek Mining Company was also operating the Crescent Mill on Big Creek, and was involved in a lawsuit brought by the town of Kellogg for polluting its public water supply with tailings being disposed of in Big Creek. The Big Creek Mining Company and the Sunshine Mining Company responded by relocating their point of waste discharge to downstream of the Kellogg water intake (Quivik 1999).

Records indicate that a significant volume of tailings accumulated near the mouth of Big Creek. It is unclear whether these tailings resulted from tailings that made their way down Big Creek or whether they were from upstream sources on the South Fork that settled out near the mouth of Big Creek. The Federal Mining & Smelting Company began to work the Big Creek tailings deposit in 1947. The material was trucked to the Polaris Mill in Osburn for concentration. In 1948, the company hauled 37,290 tons of material, and 99,600 tons of material were hauled in 1949. The tailings deposit was worked by unnamed lessees in 1950 and later by the Zanetti Brothers in 1951 and 1952 (Quivik 1999).

Production records for the mines of the Big Creek Watershed indicate that an estimated 12.4 million tons of ore were mined in the area from 1913 to 1990 (Mitchell and Bennett 1983; SAIC 1993). From this ore, an estimated 72,274 tons of lead, 53,153 tons of copper, 11,037 tons of silver, 4,508 tons of zinc and 0.34 tons of gold were produced. Approximately 92 percent of the ore production in the watershed through 1990 was from the Sunshine Mine. Tailings production for the watershed, excluding the Crescent Mine whose ore was milled at the Bunker Hill Complex, has been estimated at more than 11 million tons (SAIC 1993). Additional details of the operating history of the producing mines and mills located in the Big Creek Watershed are included in the following sections.

2.1.6.1 Mines

The mines that operated in the Big Creek Watershed for which ore production was recorded are listed in Table 2.1.6-1. This table includes the production years of the mine, estimated volumes of ore and tailings produced as a result of the mining activity and the segment in which the mine is (or was) located. Only mines with documented ore production are listed. The Sunshine Mine was the largest producer in Big Creek. Additionally, some mining operations were carried out at more than one location, occasionally in more than one segment or even more than one watershed. The ore production listed in Table 2.1.6-1 is the total production for all of the mining operations.

2.1.6.2 Mills

Table 2.1.6-2 lists the mills with operations in the Big Creek Watershed for which there are records. This table includes the operating years of the mill and a summary of ownership, and the segment which the mill is located. Not all mills are listed, as records were not available for all mills.

2.1.7 Adits

There are 12 identified adits in the Big Creek watershed. None of the 12 adits have recorded production. The adits include the Bismark, Silver Dale and Bill Hill, Rockford Group, Royal Apex, Idaho Leadville Property prospect, National, Sunshine, Crescent, and four unnamed adits.

2.2 HYDROGEOLOGY

2.2.1 Conceptual Hydrogeologic Model

The hydrogeology of the Big Creek Watershed can be divided into two main groundwater systems: the bedrock aquifer and the shallow alluvial aquifer. The conceptual hydrogeologic model for the watershed assumes that a single unconfined aquifer is present in the shallow alluvial sediments, and these sediments are the principal hydrostratigraphic unit in the watershed. The shallow alluvial sediments consist of natural materials as well as mine tailings and waste rock. In general, the alluvium increases in thickness from the headwaters of Big Creek toward its confluence with the South Fork. Very little specific hydrogeologic data are available for the Big Creek Watershed.

The bedrock aquifer within the Big Creek Watershed consists of argillites and quartzites of the Precambrian formations of the Belt Supergroup, including (principally) the Wallace Formation in the vicinity of East Fork Big Creek and West Fork Big Creek (Part 1, Figure 3.2-1). Discrete zones of the Revett, St. Regis, and Wallace Formations are drained by Big Creek in topographically lower portions of the watershed (Part 1, Figure 3.2-1). In general, the bedrock has very low permeability. Secondary features such as fractures, faults, or mine workings may increase the permeability substantially. Estimates on the number of adits and tunnels that are known to discharge mine drainage in this watershed are not available.

The groundwater system of unconsolidated sediments overlying less permeable rocks occurs primarily in an elongate, V-shaped trough along East Fork Big Creek, West Fork Big Creek, and most of Big Creek. The 2-mile reach along Big Creek above the confluence with the South Fork forms a U-shaped valley, which is up to 1,500 feet wide (Part 1, Figure 1.2-2).

As observed in wells in the Canyon Creek and Ninemile Creek Watersheds, it is assumed that groundwater levels fluctuate seasonally. Groundwater levels are generally highest in the late spring and lowest during winter and early spring when precipitation rates are lowest and snowmelt is not occurring.

2.2.2 Aquifer Parameters

Aquifer parameters are not available from the Big Creek Watershed for the presumed single unconfined aquifer in unconsolidated sediments overlying bedrock. However, based on reported lithologic similarities between the presumed single unconfined aquifer and the upper aquifer of the Smelterville Flats-Bunker Hill aquifer system, it is reasonable to expect that aquifer parameters presented in Table 2.2-1 are similar to the presumed single unconfined aquifer of the Big Creek Watershed. The range of horizontal hydraulic conductivities presented in Table 2.2-1 are typical of clean sand and gravels (Freeze and Cherry 1979).

2.2.3 Flow Rates and Directions

Based on similar watersheds (e.g., Canyon Creek and Ninemile Creek), it can be assumed that the general groundwater flow direction in the Big Creek Watershed parallels the flow of Big Creek surface water. Based on water level data recorded in Canyon Creek, it can be assumed that there are localized areas in Big Creek where the flow direction is downstream and toward the creek and some areas where the flow direction is downstream and away from the creek.

Based on an analysis of groundwater elevations in the water table aquifer in the Woodland Park area of Canyon Creek, which appears comparable to the reach approximately 1 to 2 miles above the South Fork along Big Creek, it can be assumed that groundwater in Big Creek has a fairly steep gradient generally following the ground surface topography. The gradient of 0.035 calculated for the Woodland Park area is inferred to be comparable to the 1- to 2-mile reach above the South Fork along Big Creek.

2.2.4 Surface Water/Groundwater Interaction

Based on groundwater information collected from the Canyon Creek Watershed, it can be assumed that shallow alluvial deposits along Big Creek serve as aquifers, and if they are hydraulically connected, they are capable of taking from or adding to flow in the creek. It is further assumed that the interaction of the surface water in Big Creek and groundwater in the shallow alluvial aquifers creates gaining or losing reaches. During the spring snowmelt and resulting high creek levels, the gaining reaches of the stream may temporarily experience reversals in the surface water/groundwater hydraulic gradient (i.e., become losing reaches).

2.2.5 Water Quality and Water Chemistry

Water quality parameters (temperature, pH, specific conductance, salinity, turbidity, and oxidation-reduction [redox] potential) and water chemistry data (e.g., chloride, sulfates, and sulfides) are discussed further in Section 4, Nature and Extent of Contamination and in Section 5, Fate and Transport.

2.2.6 Groundwater Use

Use of groundwater supplies for domestic, municipal, and industrial applications (as it relates to human consumption) is discussed in the Baseline Human Health Risk Assessment.

2.3 SURFACE WATER HYDROLOGY

The following sections describe the surface water hydrology of the Big Creek Watershed. The Big Creek Watershed has a drainage area of approximately 29.9 square miles, with approximately 12.8 miles of mapped channel length, and a drainage density of 0.4 miles per square mile.

2.3.1 Available Information

The U.S. Geological Survey (USGS) has several gages in the vicinity of Big Creek with historical streamflow data; most notably, USGS station number 12413140, Placer Creek at Wallace, ID. The Placer Creek gage has a drainage area of 14.9 square miles and a period of record from November 1967 to September 1995, October 1996 to September 1997, and water year 1999 (USGS 2000). These data can be used to estimate historical hydrographs and the magnitudes of discharges for floods of specific recurrence intervals within Big Creek.

In addition to the Placer Creek gage data, the USGS maintained a stream gage on Big Creek from December 3, 1970, to October 17, 1974 (USGS 2000). Although not at the mouth, these data are valuable for evaluation of the estimated discharges based on the Placer Creek data.

Stream discharge measurements were taken in association with water quality sampling events completed by McCulley, Frick & Gillman, Inc. (MFG), URS, Idaho Department of Environmental Quality (IDEQ), and USGS. These measurements have occurred since 1991. These data can be used to evaluate the adequacy of the historical hydrographs developed from the Placer Creek data. These data are summarized in Table 2.3.1-1.

In addition to the USGS hydrologic information, the U.S. Department of Housing and Urban Development, Federal Insurance Administration completed a flood insurance study (FIS) for the City of Shoshone County, Idaho (FIA 1979). Peak discharges were computed for 10-year (1,330 cubic foot per second [cfs]), 50-year (2,950 cfs), 100-year (3,925 cfs) and 500-year (7,065 cfs) events for Big Creek near the mouth. Although these values reported might be dated and coefficients used to calculate these discharges may contain some error, they do provide some basis for selecting a design discharge for remedial actions.

2.3.2 Hydrologic Description

This section provides a description of historical data available, flood frequency in the watershed, and the water year 1999 stream discharge data.

2.3.2.1 Historical Description

Continuous discharge data for Big Creek at the mouth are not available, therefore an estimate of mean daily discharge at the mouth of Big Creek was developed from historical data from Placer Creek. Mean daily discharge for Placer Creek was scaled by the ratio of the drainage areas of Big Creek to Placer Creek to produce an estimate of mean daily discharge for Big Creek for the period of record of Placer Creek. This hydrograph is presented as Figure 2.3.2-1.

To assess the adequacy of this approach, this method was applied to the drainage area upstream of the West Fork of Big Creek where the USGS operated a gage for several years in the 1970s. Mean daily discharge for Placer Creek was scaled by the drainage area of Big Creek upstream of the West Fork to Placer Creek for the period where records were available from both gages, December 3, 1970 to October 17, 1974. The difference between the estimated discharge and measured discharge was calculated, the hydrographs and difference are shown in Figure 2.3.2-2. Agreement between the estimated discharge and measured discharge is relatively good; however, 40 to 60 percent discrepancies should be expected.

From Figure 2.3.2-1, the maximum mean daily discharge is estimated at 1,800 cfs and occurred on January 15, 1974. Base flow is estimated to be 5 to 10 cfs. Average annual discharge is estimated at approximately 70 cfs. The maximum discharge recorded at the Placer Creek gage is outside the period of record; however, the USGS has estimated this discharge at 2,200 cfs on February 9, 1996. Applying the relationship presented above results in an estimate of maximum discharge for Big Creek of 4,414 cfs.

2.3.2.2 Flood Frequency

Table 2.3.2-1 presents the estimated discharges for specified flood frequency recurrence intervals for Big Creek. Because historical discharge data are not available for Big Creek and the estimates of mean daily discharge are already subject to uncertainty, additional manipulation to obtain flood frequency estimates was not completed. Instead, flood frequency developed in the FIS is presented. The bankful discharge, the approximately 1.5 year event, is estimated to be approximately 500 cfs.

2.3.2.3 Water Year 1999

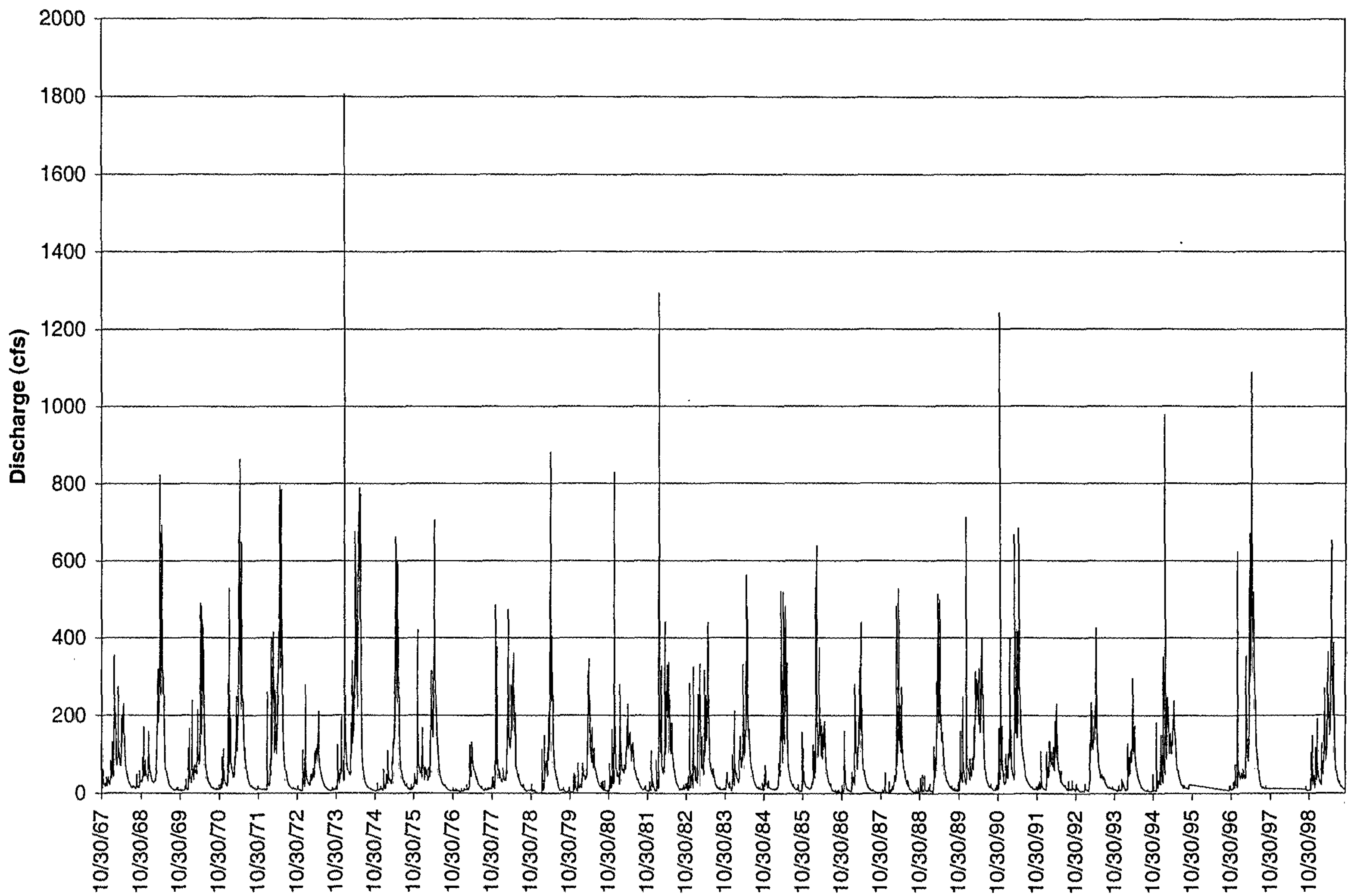
Mean daily discharge estimates for water year 1999 were completed in a similar manner as for the historical estimates. Mean daily discharge for Placer Creek was scaled by the ratio of the drainage area of Big Creek to Placer Creek to produce an estimate of mean daily discharge for Big Creek for 1999. These estimates are presented in Figure 2.3.2-3 with the measured precipitation from the Western Regional Climate Center (WRCC) precipitation gage at Kellogg. In addition, the stream discharge estimates are presented with maximum daily temperature in Figure 2.3.2-4.

Total annual average precipitation at the WRCC Kellogg Station for the 95-year period of record is 30.8 inches, while for water year 1999 the total precipitation was 37.8 inches (WRCC 2000). Total annual average snowfall for the WRCC station is 54.3 inches, while for water year 1999 the total snowfall was 35.5. While these comparisons do not address monthly variations in precipitation, they do indicate that the water budget for water year 1999 was somewhat typical, with above average total precipitation and below average snowfall.

Table 2.3.2-2 summarizes the estimated mean monthly flows for Big Creek, total monthly precipitation (rain and snow water content), and total snowfall at the WRCC station at Kellogg for water year 1999. Table 2.3.2-2 and Figures 2.3.2-3 and 2.3.2-4 indicate the majority of precipitation occurred from October to March, 78 percent of the total annual precipitation. Much of the precipitation in the upper basin was in the form of snow and did not run off into the stream channels immediately. This snow was stored in the upper basin and eventually discharged to Big Creek and ultimately the South Fork during spring and summer snowmelt.

Based on the existing data, it is expected that water Year 1999 was typical from a total snowfall and total water budget perspective in the Big Creek Watershed. Runoff from spring snowmelt dominates the surface water hydrology. Variations in snowfall, temperature, and rainfall from year to year will influence the peak discharges.

Big Creek Historic Hydrograph Estimated From Placer Creek Discharge



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027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

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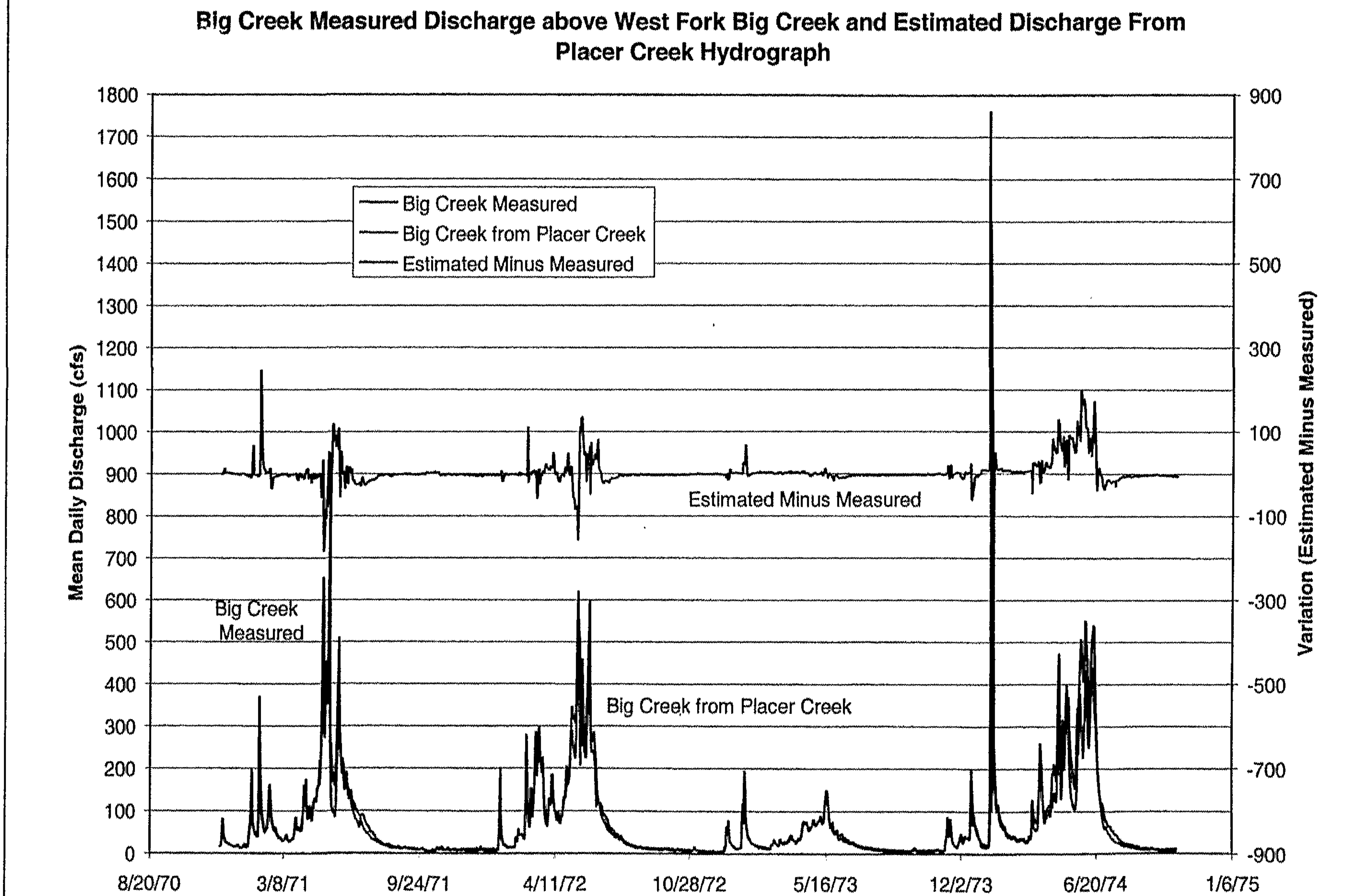
Big Creek Series
07/11/01

Figure 2.3.2-1



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Big Creek Series
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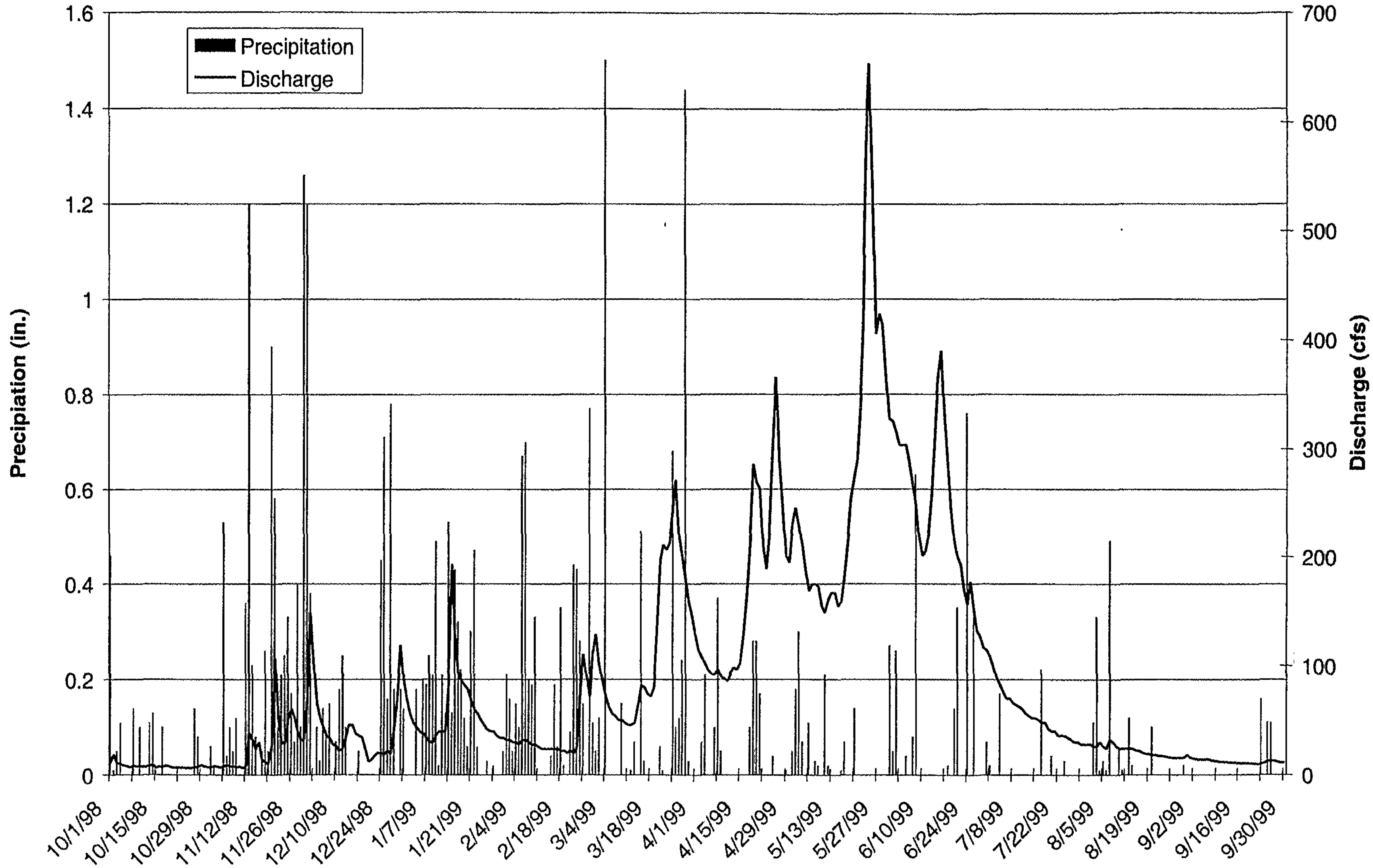
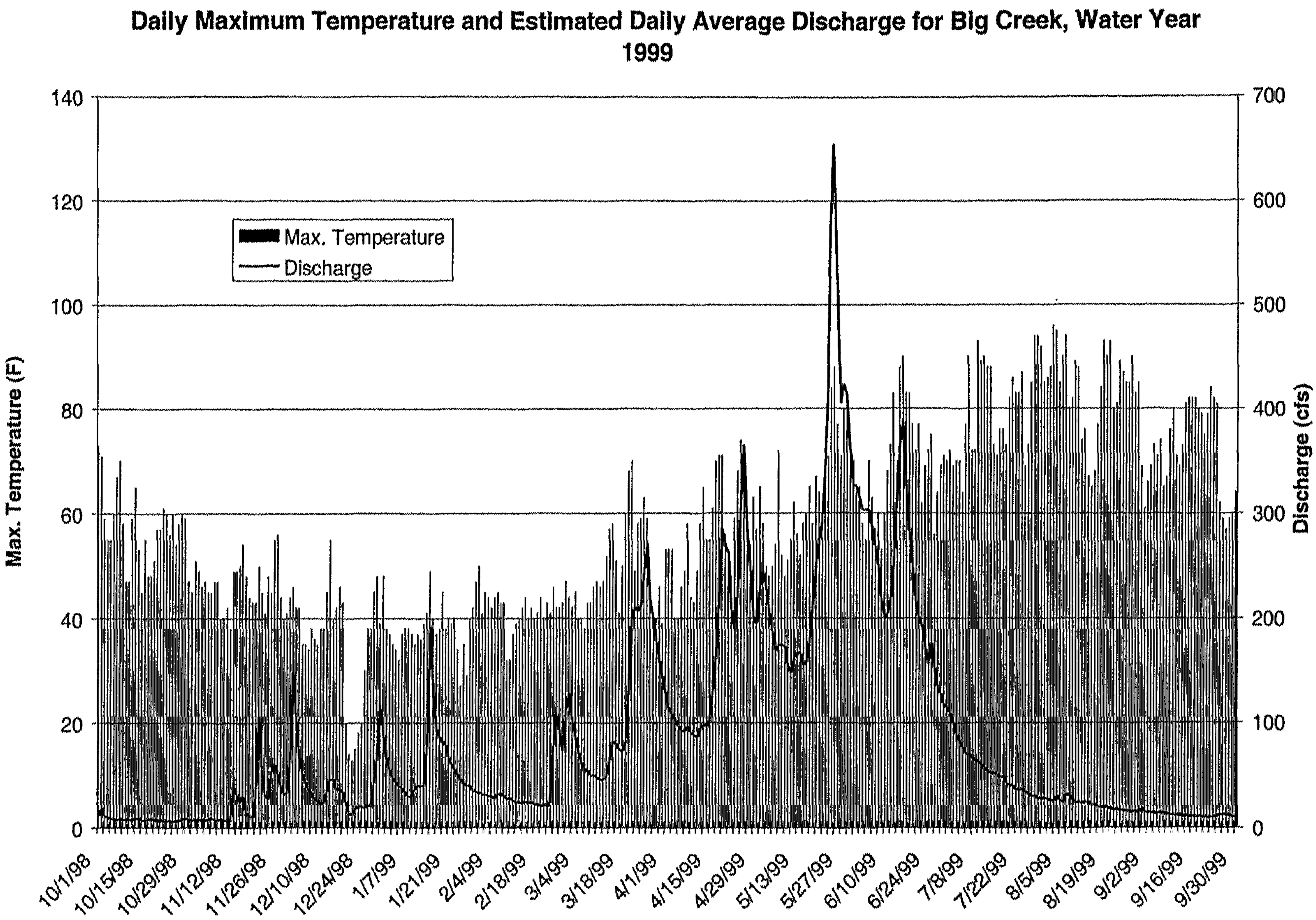
Figure 2.3.2-2

Daily Total Precipitation and Estimated Daily Average Discharge for Big Creek, Water Year 1999



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Big Creek Series 07/11/01	Figure 2.3.2-3



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Generation: 1

Big Creek Series
07/11/01

Figure 2.3.2-4

Table 2.1.6-1
Mines in the Big Creek Watershed With Recorded Production

Segment	Production Years	Ore (tons)	Mill	Tailings (tons)	Comments
Big Creek Silver Mine (part of Crescent)					
BigCrkSeg04	1913-1935	16,847	Crescent	15,608	The Big Creek Mining Company began shipping silver chloride ore in 1913. Over the next few years, crude lead sulfide ore and copper sulfide ore were also shipped from the mine. In May of 1923, the operations of the Big Creek Mining Company were taken over by the Bunker Hill Mining Company (Quivik 1999). After this time, the operating history of the mine is unclear, as it is often confused with the Crescent Mine.
Crescent Mine					
BigCrkSeg04	1924-1990	962,252	Crescent, Polaris/Silver, Summit, Bunker Hill Complex	NA	The Crescent Mine workings are located on Big Creek in the vicinity of the Sunshine Mine. The mine was opened in 1918 (Ridolfi 1998). There is some mention of production at the mine in 1918 (SAIC), but other sources claim the mine had no recorded production until 1924 (Mitchell and Bennett 1983). The mine was under control of the Bunker Hill Mining Company by 1923. The Hooper Tunnel was constructed from 1928 through 1930. Production at the mine continued through the 1940s but was apparently ceased sometime thereafter, to be reactivated again in 1953 (SAIC 1993).

Table 2.1.6-1 (Continued)
Mines in the Big Creek Watershed With Recorded Production

Segment	Production Years	Ore (tons)	Mill	Tailings (tons)	Comments
Sunshine Mine					
BigCrkSeg04	1904-1990	11,453,874	Sunshine	11,004,701	The Sunshine Mining Company was organized in December 1920 and incorporated shortly thereafter. The company acquired the Yankee Boy and Yankee Girl Mines, which had originally been located by True and Dennis Blake. These mines had been worked by leasers since the Blakes ceased their mining operations in 1914. The company built a two bucket aerial tramway to carry ores from the mine to the newly constructed Sunshine Mill (Quivik 1999). Operations of the mine flourished, when in 1933 an extremely rich ore find was made. In 1943, the Chester ore body was struck. This discovery was made through a profit sharing agreement that included the Polaris Mining Company, Silver Dollar Mining Company, Silver Syndicate Mining Company and the Sunshine Mining Company. These companies were eventually merged with the Sunshine Mining Company in the early 1980s (SAIC 1993). The mine continues to be active during present day (Ridolfi 1998).

Source: Stratus 1999, unless otherwise noted

Table 2.1.6-2
Mills With Documented Operations in Big Creek Watershed

Segment	Operating Years	Ownership	Comments
Sunshine Mill			
BigCrkSeg04	1921-Present	Sunshine Mining Company	The Sunshine Mining Company completed construction of the 50-ton Sunshine Mill in August 1921. By the end of that year, the mill's capacity had been increased to 75-ton per day. About this time, Sunshine and the Big Creek Mining Company jointly constructed an 11,000 foot flume to carry flotation slimes to the mouth of Big Creek (see Crescent Mill below). The mill's capacity was expanded to 100-120 tons per day in 1925 and the mill produced 1,000 tons of concentrates. A complete remodeling of the mill in 1929 increased its capacity to 500-tons. A major flood destroyed or damaged most of the mill buildings in 1933. The Sunshine was taken over by a New York development firm in 1934 and by March 1935 the mill's capacity had been increased to 750 tons. By 1939, the mill was handling 1,000 tons per day, and by 1941, the company was building a new 1,200-ton differential flotation plant for recovery of antimony. This plant was operated until March 1944, when it was closed due to labor shortages caused by World War II. The Sunshine Mill continued to operate regularly through the 1940s, and treated ores of the Polaris Mining Company, Silver Syndicate, Inc., Silver Dollar Mining Company, and Metropolitan Mines Corporation. The antimony plant was reopened in 1953 and both mills continued to operated regularly for the next twenty-plus years. The Sunshine Mill is still currently operating (Quivik 1999).

Table 2.1.6-2 (Continued)
Mills With Documented Operations in Big Creek Watershed

Segment	Operating Years	Ownership	Comments
Crescent Mill			
BigCrkSeg04	1919-1944	Big Creek Mining Company, Bunker Hill Company, Bunker Hill & Sullivan, E.G. Smith[a]	The Big Creek Mining Company began construction of a 60-ton mill for lead-silver ore in 1919. Shortly thereafter, the town of Kellogg brought legal action against the Big Creek Mining Company for polluting Kellogg's domestic water supply with tailings dumped into Big Creek. Big Creek Mining Company joined with the Sunshine Mining Company in 1921 to construct an 11,000-foot flume designed to carry slimes downstream of Kellogg's domestic water source area. The Bunker Hill Company took charge of mining operations at Big Creek in 1923. Bunker Hill & Sullivan took charge of the Big Creek Mining Company property in 1927. A new flotation plant, now called the Crescent Mill, was built shortly thereafter, and used to treat ore from both the Alhambra and Crescent Mines. The mill operated continuously until 1943. E.G. Smith leased the mill during 1943 and 1944 to treat approximately 38,000 tons of tailings. The buildings and tailings were removed from the site sometime between 1951 and 1961 (Quivik 1999).

[a]Operated mill through lease agreement.

Note: Table based on information from Quivik 1999.

Table 2.2-1
Summary of Aquifer Parameters of the Smelterville Flats-Bunker Hill Upper Aquifer

Hydrostratigraphic Unit	Horizontal Hydraulic Conductivity (ft/day)	Vertical Hydraulic Conductivity (ft/day)	Transmissivity 2 (ft/day)	Storativity (unitless)	Effective Porosity
Upper Aquifer	500 - 10,790	0.0025[a]	10,002 - 216,852	0.0015 - 0.09	23.6 - 29.0

[a]Based on one test conducted on a sample of upper aquifer alluvium from borehole GR-26U at 13.5 feet below ground surface. No units given in original source document.

Source: MFG (1992)

Table 2.3.1-1
Summary of Discharge Data From Project Database
Segment BigCrkSeg04

Segment Name	Site Location	Measured By	No. of Readings	Beginning Date	Ending Date	Minimum Discharge	Maximum Discharge	Units
BigCrkSeg04	BC 260	MFG, URS, USGS	5	05/14/91	05/25/99	5.61	604	cfs

cfs - cubic feet per second

Table 2.3.2-1
Estimated Recurrence Intervals, Big Creek

Recurrence Interval (Years)	Federal Insurance Study (FIS) Big Creek Near Mouth Estimated Peak Flow (cfs)
2	not available
5	not available
10	1,330
25	not available
50	2,950
100	3,925

cfs - cubic feet per second

Table 2.3.2-2
Precipitation Summary and Discharge Comparison for Water Year 1999
Kellogg, Idaho
NOAA Cooperative Station 104831

Climate Indicators	Monthly Totals												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Total
Total Precipitation (in.)	1.4	7.5	5.3	4.6	5.7	5.1	1.7	1.5	2.7	0.5	1.3	0.4	37.8
Total Snowfall (in.)	0.0	0.8	11.0	5.2	13.1	5.1	0.3	0.0	0.0	0.0	0.0	0.0	35.5
Average Precipitation for Period of Record (in.)	2.7	3.8	3.9	3.7	2.8	2.9	2.4	2.5	2.2	1.0	1.1	1.7	30.8
Average Snowfall for Period of Record (in.)	0.3	5.0	14.1	18.5	10.1	5.6	0.7	0.0	0.0	0.0	0.0	0.0	54.3
Estimated Mean Monthly Discharge (cfs) (Big Creek at Mouth)	8.3	25.5	44.3	57.9	38.0	118.5	167.6	276.5	237.6	53.2	21.7	11.9	88.6

cfs - cubic feet per second

3.0 SEDIMENT TRANSPORT PROCESSES

The Big Creek Watershed contains four segments referred to as BigCrkSeg01 to BigCrkSeg04. Big Creek enters the South Fork approximately 3 miles upstream of Kellogg, Idaho. Sediment derived in Big Creek is transported to the South Fork. Based on review of aerial photographs, sediment sources in Big Creek are mining waste, mobilization of channel bed sediment, bank erosion, and some rock debris situated adjacent to channels. In this discussion, the available information, analyses, and likely sediment sources are described.

3.1 AVAILABLE INFORMATION

Sediment transport data are not available for areas within Big Creek. One year of sediment transport gaging data is available for Canyon and Ninemile Creeks; drainages of similar size that are located near Big Creek. The topography of the Big Creek Watershed is similar to that of Canyon and Ninemile; however, land use practices in the Big Creek Watershed are substantially different than in Canyon and Ninemile Creeks. Big Creek has been less heavily impacted by mining and other disturbances throughout the Watershed than in the Canyon and Ninemile Creek Watersheds. Even with the differences, data from Canyon and Ninemile Creeks may be used to provide useful insight into the possible magnitude of sediment transport from Big Creek.

Historical and current aerial photography are available. For Big Creek, 1998 photographs by URS Greiner, Inc. (URSG) and CH2M HILL, Inc. (URSG and CH2M HILL 1999), and by U.S. Department of Agriculture (USDA) (USDA 1991) were reviewed.

3.2 ANALYSES

3.2.1 USGS Sediment Gaging Data

Because no sediment transport data were collected for Big Creek, estimates of sediment transport for 1999 were made using the sediment transport analysis from Canyon and Ninemile Creeks. The USGS sediment transport data for Canyon and Ninemile Creeks were analyzed in general accordance with the Army Corps of Engineers (USACE) guidance manual for sedimentation investigations (USACE 1989). These analyses are presented in separate sections.

These analyses produced annual sediment yields for Canyon and Ninemile Creeks for three size classes of particles, fines, sand, and bedload, expressed as tons per square mile of drainage area. Although land use in these watersheds is different than the land use in Big Creek, these sediment yields were used to estimate sediment yield in Big Creek. The sediment yield per drainage area was averaged for each size class and applied to Big Creek to estimate an annual sediment yield for water year 1999. The results are presented in Table 3.2-1. These estimates likely overestimate the amount of sediment transport because far fewer discrete sources exist in the Big Creek Watershed than in the Canyon and Ninemile Creek Watersheds.

This simplistic analysis only provides guidance to approximate quantities of sediment transported by Big Creek in water year 1999 based on the watershed size and estimates of sediment transport from watersheds with similar land use. Sediment yields can vary significantly from year to year and basin to basin based on hydrologic conditions, sediment inputs, changing land use, and other conditions.

3.2.2 Channel Classification

Channel classifications may provide a level of understanding and description of a channel behavior. Some channel classification systems require fieldwork and in depth study while others only require topographic map and aerial photograph interpretation. The level of information provided by a classification based solely on topographic map and aerial photograph interpretation is limited, but does provide a basic framework for channel processes and conditions.

Rosgen and Silvey (1996) proposed a classification that delineates channel types based on plan-view morphology, cross-section morphology, channel sinuosity, channel slope, and bed features to provide a broad level delineation. Aerial photograph and topographic map interpretation can be used for this type of classification, Level 1. The Rosgen methodology builds from this broad classification when combined with more detailed information. The Rosgen Level 1 classification was used for this study to identify broad reach level channel morphologies.

Electronic USGS 7 ½ minute quadrangle maps containing three dimensional topographic data were analyzed using AutoCAD Land development software. Plots of channel profile and slope were produced for each segment of Big Creek, Figures 3.2-1 through 3.2-8. In general, the divisions between segments were established based on changes in channel type or other morphologic feature, as such; each segment contains one or two channel types. The channel type was determined based on channel slope and observation of aerial photographs from 1998.

Channel stationing was established from the confluence of Big Creek with the South Fork at 100-foot stations upstream from the mouth for ease of locating specific features. This stationing is indicated on Figures 3.2-1 through 3.2-8. This stationing is approximate and is intended for general locating of discussed areas. More detailed stationing and survey should be used for precise locating and project construction.

In the Big Creek Watershed, four Rosgen stream types occur, "Aa+", "A", "B", and "C". The following paragraphs briefly summarize these four types of channel and the mapping effort of channel classification.

"Aa+" streams are very steep, greater than 10 percent, well entrenched, and laterally confined. Sediment supply is often high due to the high energy, steep channel slopes and narrow channel cross sections. Bedforms associated with this channel type include waterfalls, cascades, and step-pools. Debris flows often initiate in "Aa+" type channels. In Big Creek, structural control from joints, faults, or bedding may influence the locations of "Aa+" type channels.

"A" stream types are similar to "Aa+" in that similar bedforms and channel characteristics are common to both types; however, "A" stream types have slopes which range from 4 to 10 percent. Generally, "A" stream types have high sediment transport potential with little in channel sediment storage capacity due to the channel slope. Large woody debris can play a major role in the bedform and channel stability in "A" type streams.

"B" stream types are moderately steep to gently sloped channels, 2 to 4 percent. Faults, joints, contacts often influence "B" type channels by restricting the development of wide floodplains. Stream erosion rates, aggregation and degradation rates are generally low. Lateral movement of "B" type channels is typically low. Rapids and scour pools are typical bed forms in type "B" channels.

"C" stream types generally are located in valleys constructed from alluvial deposition, with well-developed floodplains. Primary morphologic features of the "C" stream type are the sinuous low relief channel, and the well-developed floodplain built from sediment derived in part from the river. Lateral migration, aggregation and degradation rates in "C" type channels are dependent on the stability of the banks, discharge and sediment supply from upstream. "C" type channels may be significantly altered by changes in bank stability, discharge, or sediment supply.

The channel types within the Big Creek Watershed are identified on the topographic maps, Figures 3.2-1 through 3.2-4. Based on the topographic maps and sections, in general, segment BigCrkSeg04 contains lower gradient type "C," with occasional steeper sections classified as type "A". Segment BigCrkSeg03 contains type "A+", "A" and "B" type channels. Segment BigCrkSeg02 contains type "B" and "C" channels. Segment BigCrkSeg01 contains type "A", "B", and "C" channels. The topography shown on Figures 3.2-1 through 3.2-4 produces the unusual sequence of channel types mapped in the watershed because low gradient segments of the channel are truncated by high gradient segments of the channel. Field verification of the actual slopes should be completed.

IDEQ developed a Rosgen classification for one 116-meter reach in lower East Fork Big Creek (BigCrkSeg02) under the BURP project (see Figures 3.2-2 and 3.2-6). This reach was selected to be representative of general conditions in that area of the watershed. The reach was classified as Rosgen type B, which agrees with the classification presented here (IDEQ 1998, 1999). Both classifications are preliminary in nature and are presented for baseline characterization purposes only. They are not intended for use in the design phase of remedial planning. Detailed, site-specific hydrologic studies may be needed to guide actual remedial design development.

3.2.3 Channel Descriptions

The 1998 set of aerial photographs by URS Greiner and CH2MHILL, the 1991 photographs by USDA, and the topographic maps and profiles presented on Figures 3.2-1 through 3.2-8 were reviewed to further describe Big Creek. This review and interpretation focused on morphologic features indicating stream instability, channel migration, channel aggregation or degradation and other features that may contribute sediment to the system.

3.2.3.1 Segment BigCrkSeg01 (Station 270+00 to 440+00)

Segment BigCrkSeg01 has approximately 17,000 feet, or 3.2 miles, of mapped channel as indicated on Figure 3.2-1. The channel slope varies from approximately 5 to 15 percent (Figure 3.2-5). Aerial photograph coverage extended to approximately station 309+00. The channel is confined in a narrow valley by vegetated steep hillslopes through this section. These hillslopes constrain the position of Big Creek through this reach. The only sources of sediment identified are from channel bed remobilization and minor bank erosion.

3.2.3.2 Segment BigCrkSeg02 (Station 270+00 to 422+00)

Segment BigCrkSeg02 has approximately 15,200 feet, or 2.9 miles, of mapped channel as indicated on Figure 3.2-2. The channel slope varies from approximately 5 to more than 20 percent (Figure 3.2-6). Aerial photograph coverage extends to approximately station 345+00. The channel is confined in a narrow valley by vegetated steep hillslopes through this section.

These hillslopes constrain the position of Big Creek through this reach. The only sources of sediment identified are from channel bed remobilization and minor bank erosion.

3.2.3.3 Segment BigCrkSeg03 (Station 167+00 to 250+00)

Segment BigCrkSeg03 has approximately 8,300 feet, or 1.6 miles, of mapped channel as indicated on Figure 3.2-3. The channel slope varies from about 5 to more than 15 percent (Figure 3.2-7). The channel is confined in a narrow valley by vegetated steep hillslopes through this section. These hillslopes constrain the position of Big Creek through this reach. The only sources of sediment identified are from channel bed remobilization and minor bank erosion.

3.2.3.4 Segment BigCrkSeg04 (Station 0+00 to 167+00)

Segment BigCrkSeg04 has approximately 16,700 feet, or 3.2 miles, of mapped channel as indicated on Figure 3.2-4. The channel slope varies from 1 to approximately 10 percent (Figure 2.3-8). Sediment sources in this reach include channel bed remobilization, minor bank erosion, and a few areas surrounding mine and quarry operations provided a surface water connection exists to Big Creek.

From station 0+00 to 50+00, Big Creek is aligned adjacent to two tailings ponds from the Sunshine Mine. Sunshine Tailings Pond #1 is vegetated while Pond #2 appears to be currently in use based on unvegetated tailings at the pond surface. No obvious surface water connection between the ponds and the creek was observed in the photographs reviewed. These ponds could be a sediment source if a surface water connection exists.

Big Creek, from station 47+00 to 110+00, flows through a valley bottom 200 to 1,000 feet wide and is constrained in location by dikes. Channel slope varies from 1.5 to 2 percent. The valley bottom from station 102+00 to 104+00 is developed with structures. The only likely sediment sources in this reach are channel bed remobilization and minor bank erosion.

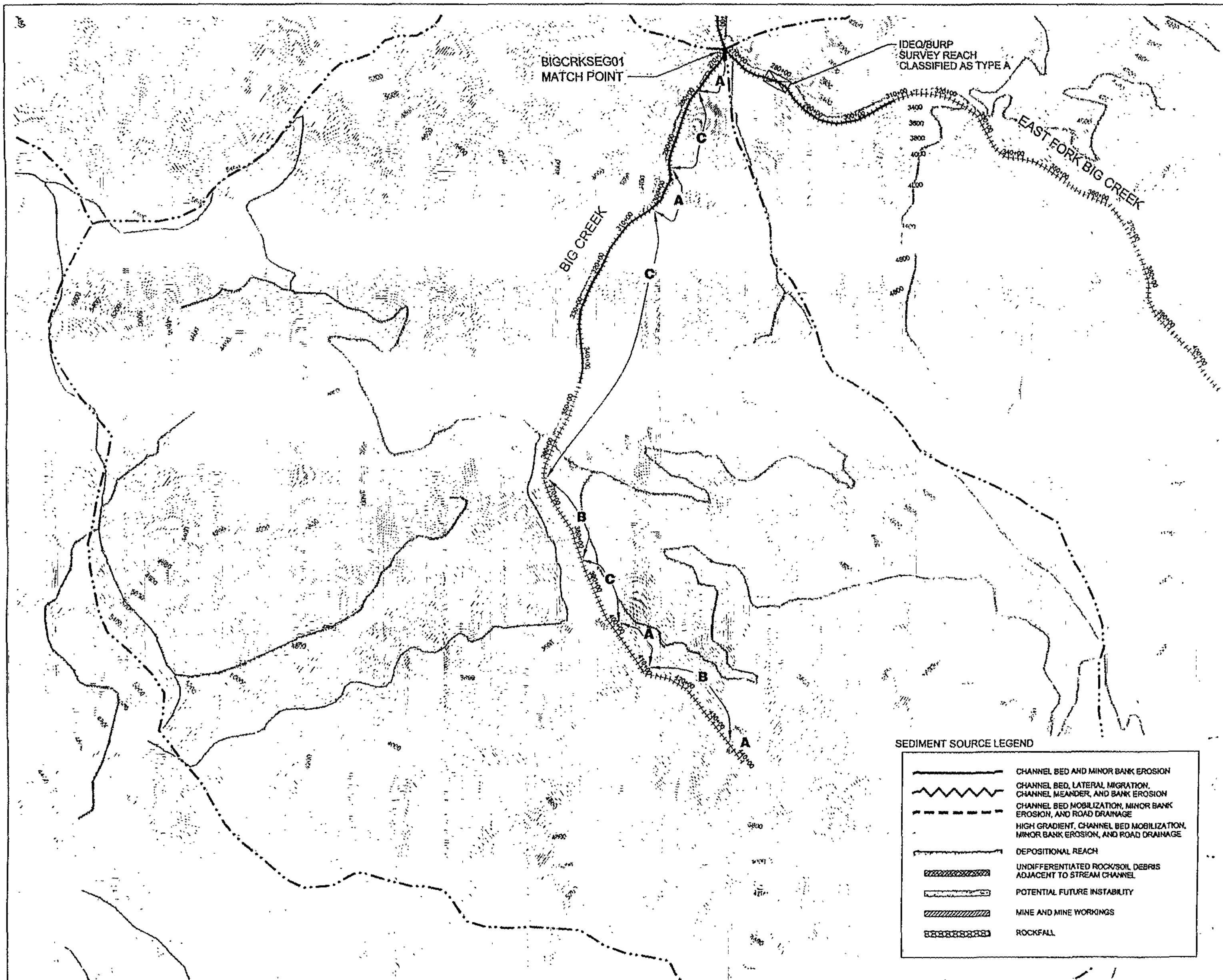
From station 110+00 to 167+00, the channel is confined in a narrow valley bottom by road embankments and hillslopes. A mine opening indicated by exposed rock from the Crescent Hooper Tunnel is located at approximately station 110+00. No obvious surface water connection was observed in the photographs. From station 118+00 to 130+00 on the east bank of Big Creek, the operations and mill complex of the Sunshine Mine are located. Exposed rock is situated on the hillside above the buildings. No obvious surface water connection between the exposed soils surrounding the buildings was observed; however, if a connection exists, this may be a sediment source to Big Creek. In absence of a surface water connection to Big Creek, the likely sediment sources in this reach are remobilization of channel bed and minor bank erosion.

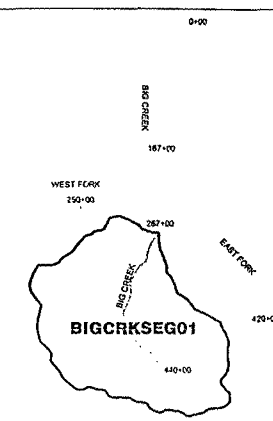
Big Creek from station 167+00 to 267+00 is confined in location by road embankments and steep hillslopes. Channel slope through this reach is approximately 1 to 5 percent. From station 210+00 to 220+00, the Big Creek Gravel Pit is situated on the hillslope above Big Creek. If a surface water connection exists to Big Creek, this may be a sediment source. The likely sediment sources in this reach are remobilization of channel bed and minor bank erosion.

3.3 SUMMARY

The Big Creek Watershed appears to provide little sediment to the South Fork, as indicated by the relatively few sediment sources within the watershed. Sediment derived in the Big Creek Watershed likely is produced from remobilization of channel bed material and minor bank erosion. Other point sources may contribute sediment provided they are connected to Big Creek by surface water. The estimate of sediment transport for water year 1999 is likely high because fewer discrete sources exist in Big Creek than in the watersheds from which the estimate was made.

Figure 3.2-1
Big Creek Segment 01 Site Plan





LEGEND

- BASIN BOUNDARY
- CONTOUR LINE
- CHANNEL CENTERLINE
- INTERSTATE/ROAD/TRAIL
- Aa+ ROSGEN CLASSIFICATION

NOTES:

1. MAP FEATURES AND CONTOURS PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. CONTOUR INTERVAL IS 25 FEET.
4. CHANNEL CENTERLINE TAKEN AT APPROXIMATE LOW POINT OF STREAM CHANNEL.
5. SEDIMENT SOURCE LOCATIONS ARE APPROXIMATE AND ARE BASED ON TOPOGRAPHIC MAP AND AERIAL PHOTOGRAPH INTERPRETATION.

N W E S

0 2000 4000
Scale in Feet

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI Report

EPA REGION 10

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Generation: 1
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Layout: BCSeg01
07/20/2000

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 20, 2000

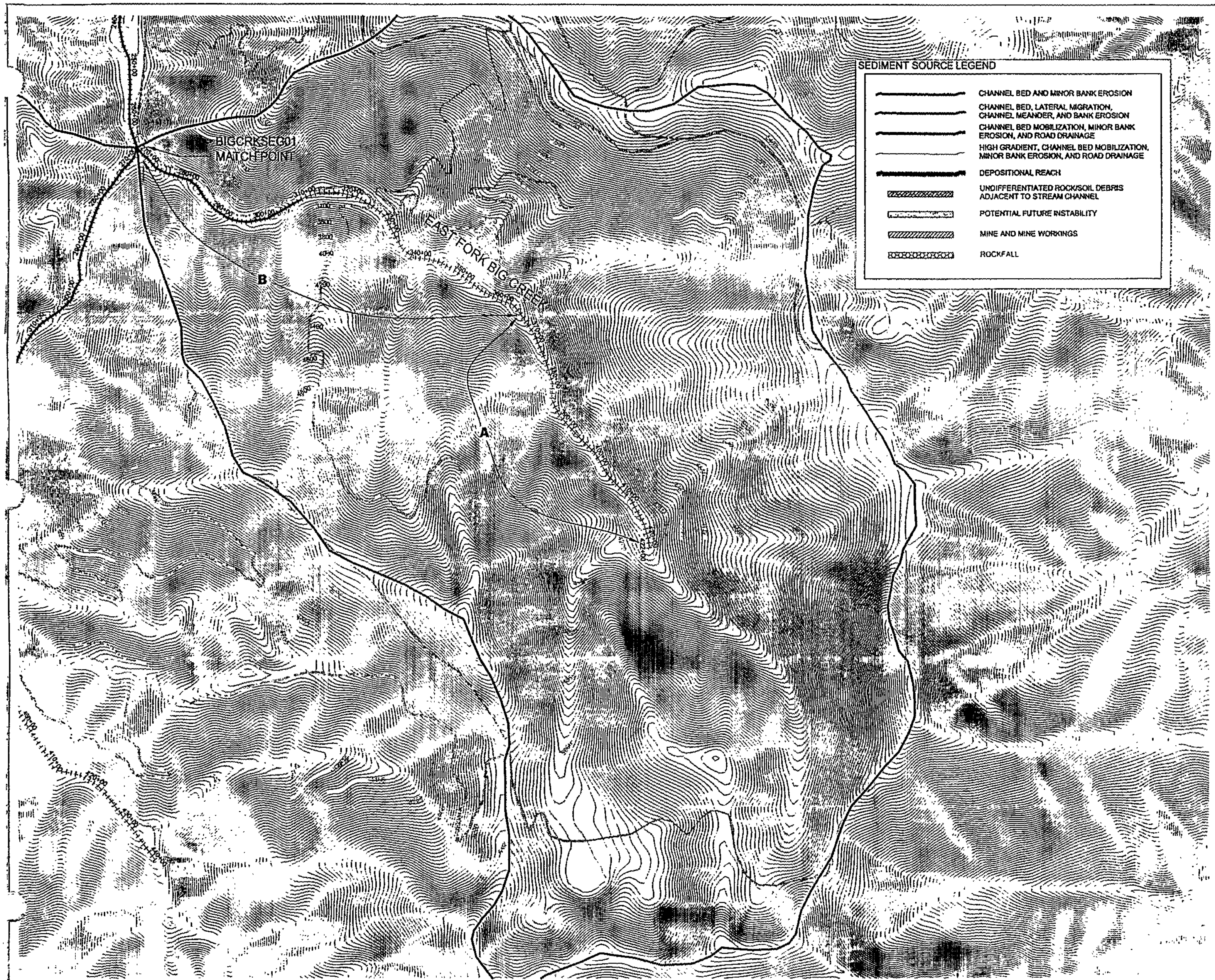
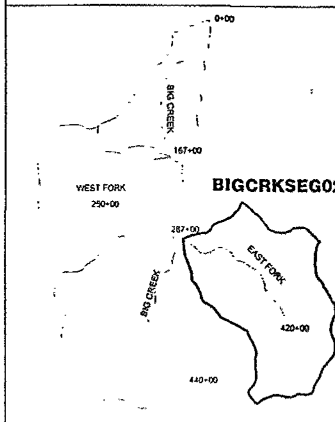


Figure 3.2-2
Big Creek Segment 02 Site Plan



LEGEND

- BASIN BOUNDARY
- CONTOUR LINE
- CHANNEL CENTERLINE
- INTERSTATE/ROAD/TRAIL
- Aa+ ROSGEN CLASSIFICATION

NOTES:

1. MAP FEATURES AND CONTOURS PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. CONTOUR INTERVAL IS 25 FEET.
4. CHANNEL CENTERLINE TAKEN AT APPROXIMATE LOW POINT OF STREAM CHANNEL.
5. SEDIMENT SOURCE LOCATIONS ARE APPROXIMATE AND ARE BASED ON TOPOGRAPHIC MAP AND AERIAL PHOTOGRAPH INTERPRETATION.

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Scale in Feet

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Coeur d'Alene Basin RI/FS
RI Report

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7/13/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 13, 2001

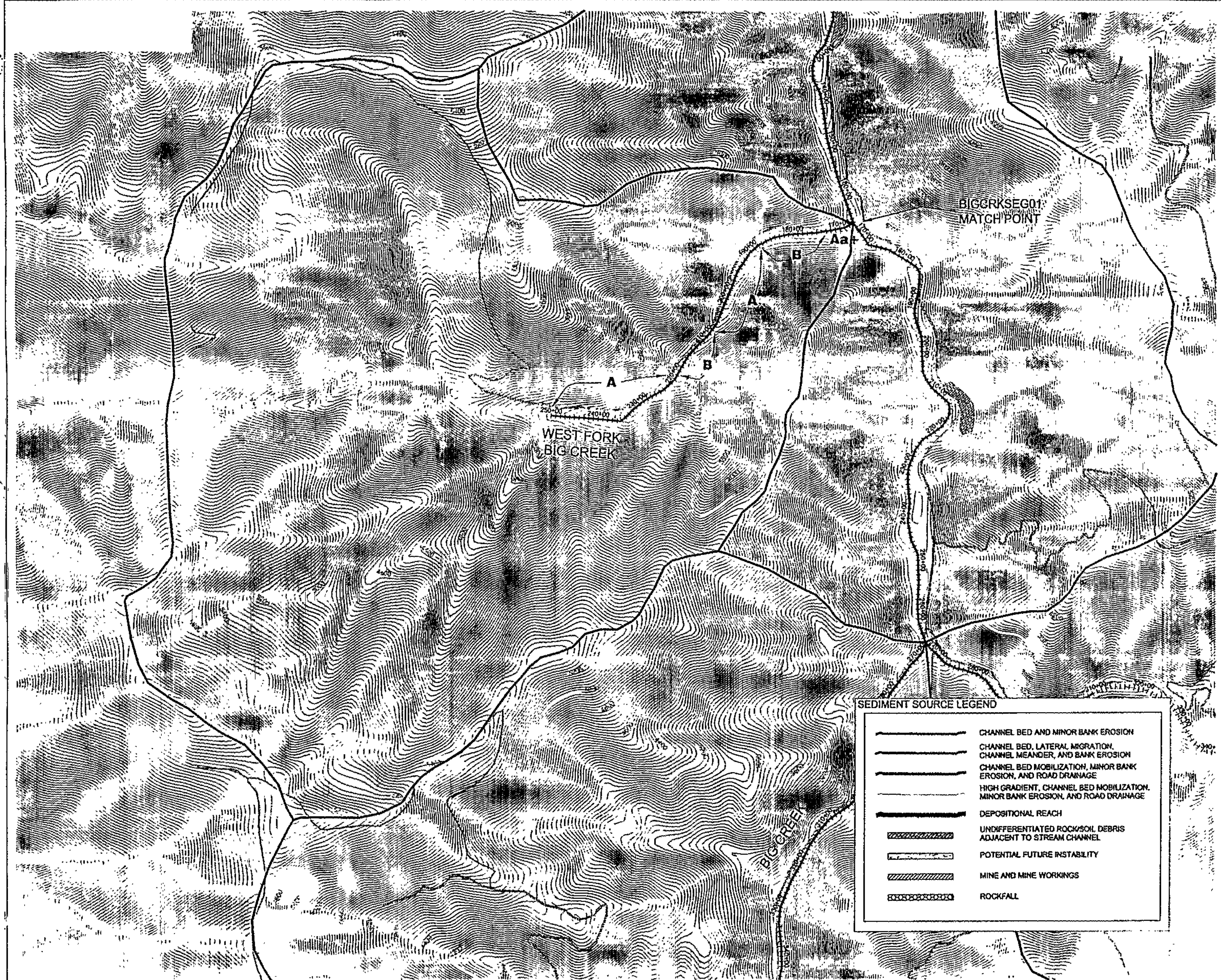
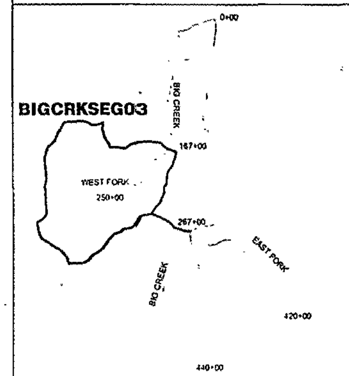


Figure 3.2-3
Big Creek Segment 03 Site Plan



LEGEND

	BASIN BOUNDARY
	CONTOUR LINE
	CHANNEL CENTERLINE
	INTERSTATE/ROAD/TRAIL
Aa+	ROSGEN CLASSIFICATION

NOTES:

1. MAP FEATURES AND CONTOURS PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. CONTOUR INTERVAL IS 25 FEET.
4. CHANNEL CENTERLINE TAKEN AT APPROXIMATE LOW POINT OF STREAM CHANNEL.
5. SEDIMENT SOURCE LOCATIONS ARE APPROXIMATE AND ARE BASED ON TOPOGRAPHIC MAP AND AERIAL PHOTOGRAPH INTERPRETATION.

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Coeur d'Alene Basin RI/FS
RI Report

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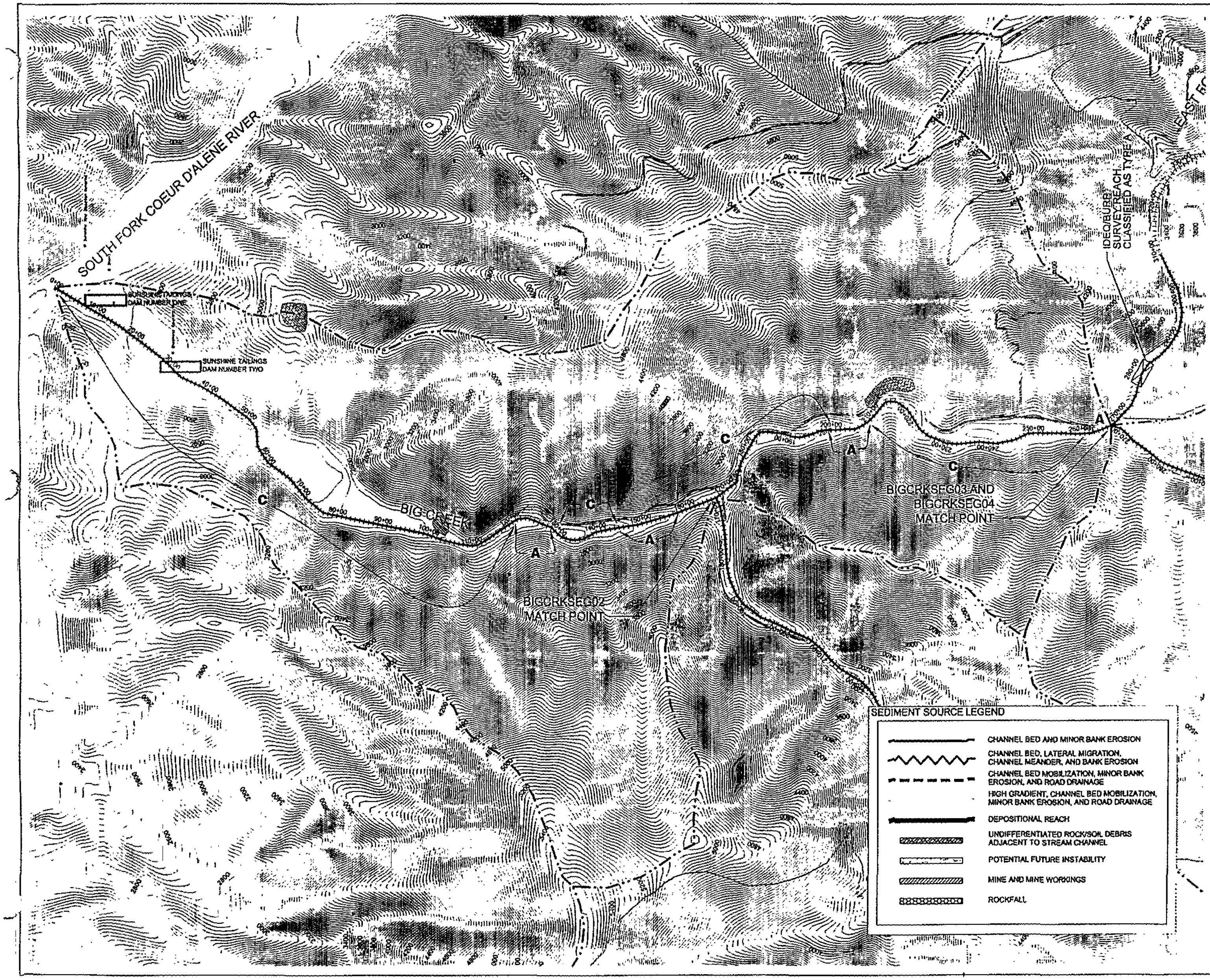
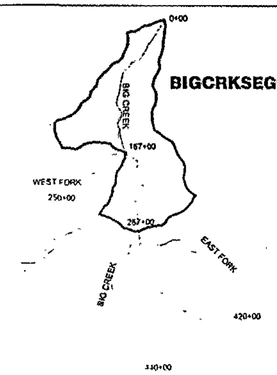
UPPERSFCDASeg01
07/13/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 13, 2001

Figure 3.2-4
Big Creek Segment 04 Site Plan





LEGEND

- BASIN BOUNDARY
- CONTOUR LINE
- CHANNEL CENTERLINE
- INTERSTATE/ROAD/TRAIL
- Aa+ ROSGEN CLASSIFICATION

NOTES:

1. MAP FEATURES AND CONTOURS PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. CONTOUR INTERVAL IS 25 FEET.
4. CHANNEL CENTERLINE TAKEN AT APPROXIMATE LOW POINT OF STREAM CHANNEL.
5. SEDIMENT SOURCE LOCATIONS ARE APPROXIMATE AND ARE BASED ON TOPOGRAPHIC MAP AND AERIAL PHOTOGRAPH INTERPRETATION.

E N S W

0 2000 4000
Scale in Feet

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI Report

EPA
REGION 10

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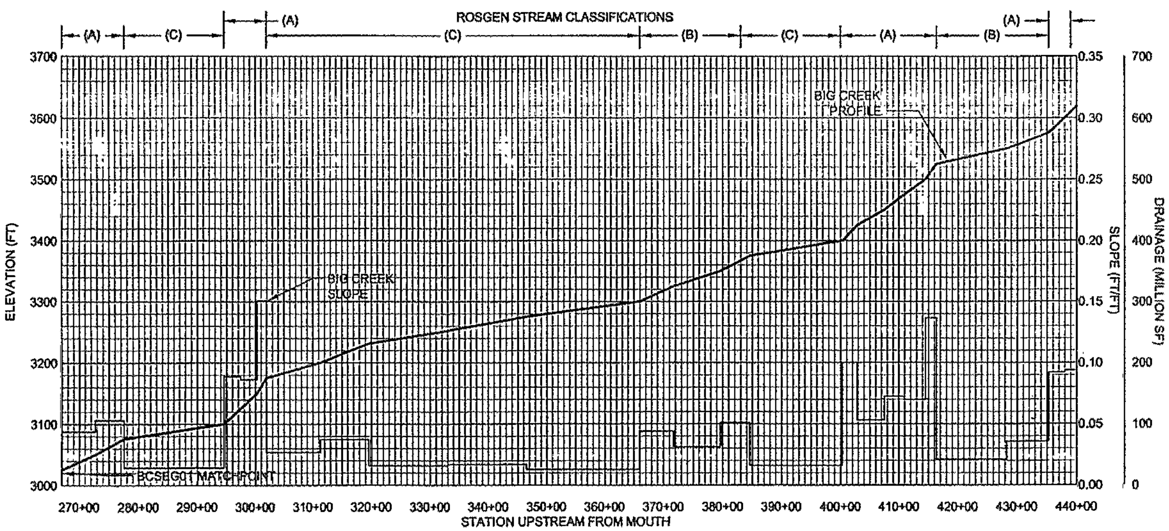
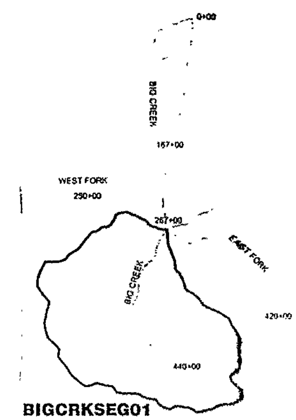
Layout: BCSeg04
07/20/2001

This map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 30 2000

Figure 3.2-5
Big Creek Segment 01
Rosgen Stream Classification





LEGEND

- SEGMENT PROFILE
- SEGMENT SLOPE
- SEGMENT DRAINAGE AREA (SF)

NOTES:

1. CHANNEL PROFILE AND SLOPES ARE APPROXIMATE AND BASED ON MAP PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. DRAINAGE AREAS ARE APPROXIMATE AND MAY NOT BE LINEAR AS INDICATED BY PLOT.

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI Report

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REGION 10

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Generation: 1
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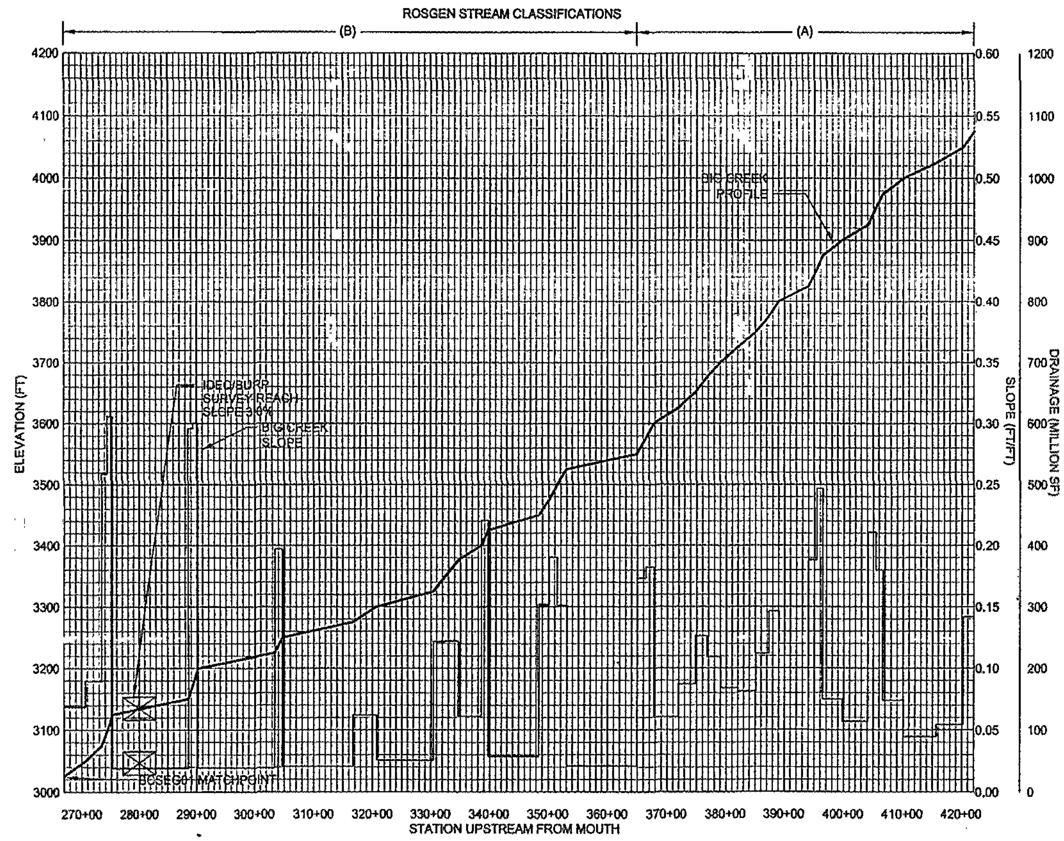
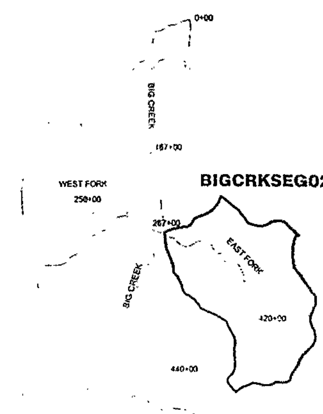
\Big Creek\Big_Section dwg
Layout: BCSeg01
07/13/2001

Figure 3.2-6
Big Creek Segment 02
Rosgen Stream Classification





LEGEND

- SEGMENT PROFILE
- SEGMENT SLOPE
- SEGMENT DRAINAGE AREA (SF)

NOTES:

1. CHANNEL PROFILE AND SLOPES ARE APPROXIMATE AND BASED ON MAP PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. DRAINAGE AREAS ARE APPROXIMATE AND MAY NOT BE LINEAR AS INDICATED BY PLOT.

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI Report

EPA REGION 10

Doc. Control: 4162500 6615 05a
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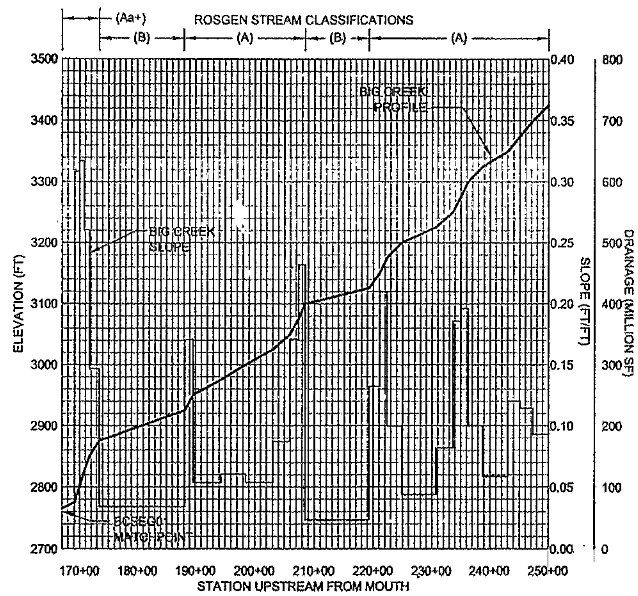
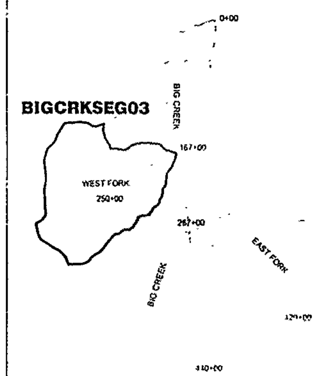
07/13 2001

Figure 3.2-7
Big Creek Segment 03
Rosgen Stream Classification





LEGEND

SEGMENT PROFILE

SEGMENT SLOPE

SEGMENT DRAINAGE AREA (SF)

NOTES:

1. CHANNEL PROFILE AND SLOPES ARE APPROXIMATE AND BASED ON MAP PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. DRAINAGE AREAS ARE APPROXIMATE AND MAY NOT BE LINEAR AS INDICATED BY PLOT.

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI Report

EPA
REGION 10

Doc Control: 4162500.6515.05.a
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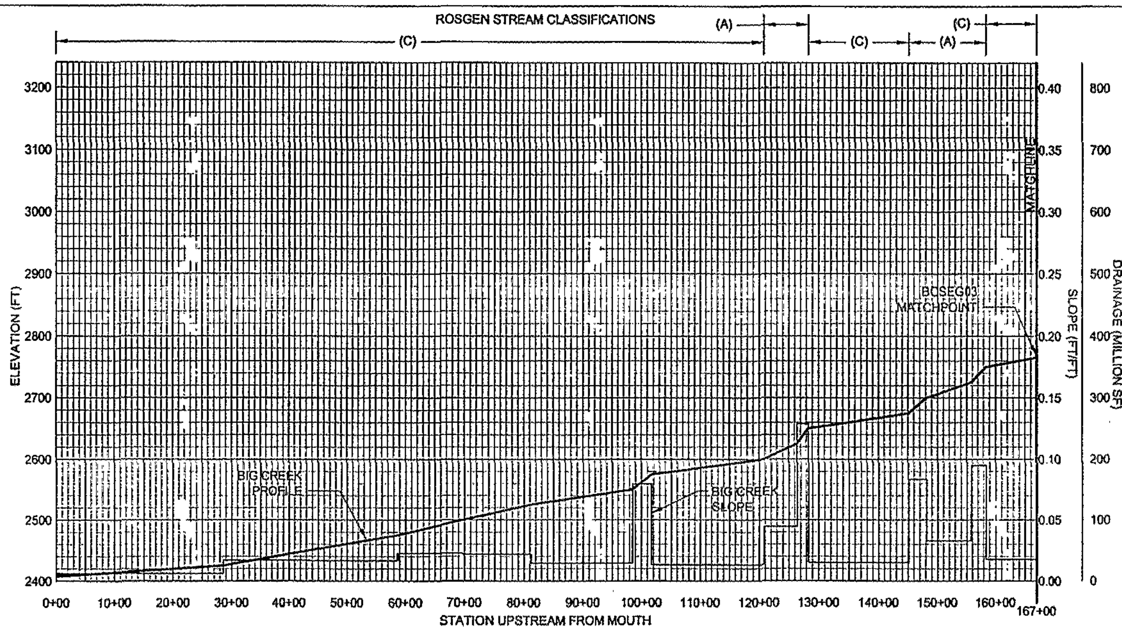
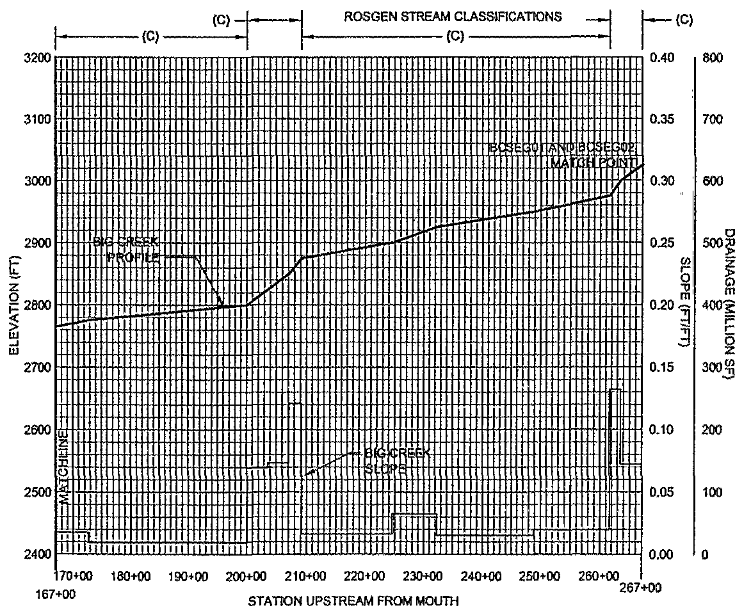
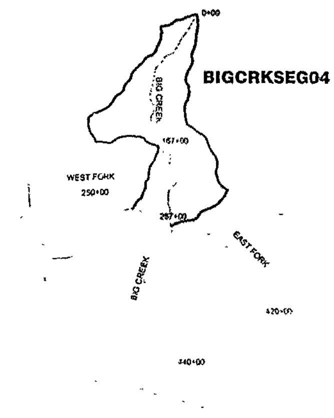
Layout: BCSeg03
07/14/2001

Figure 3.2-8
Big Creek Segment 04
Rosgen Stream Classifications







LEGEND

SEGMENT PROFILE

SEGMENT SLOPE

SEGMENT DRAINAGE AREA (SF)

NOTES:

1. CHANNEL PROFILE AND SLOPES ARE APPROXIMATE AND BASED ON MAP PRODUCED BY AMERICAN DIGITAL CARTOGRAPHY, COPYRIGHT 1995, AND BASED ON 7.5 MINUTE SERIES MAPS, REVISED 1977, ZONE ID-W.
2. VERTICAL DATUM BASED ON NAD83 IDAHO STATE PLANE COORDINATE SYSTEM.
3. DRAINAGE AREAS ARE APPROXIMATE AND MAY NOT BE LINEAR AS INDICATED BY PLOT.

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI Report

EPA REGION 10

Doc. Control: 4162500.6615.05a
Generation: 1
Path: N:\Coverages\Others\Shannon&Wilson\Big Creek\BigCreek_Section.dwg
Layout: BCSeg04
07/14/01

Table 3.2-1
Estimated Total Sediment Transport, Big Creek
Water Year 1999

	Estimated Sediment Yield Ninemile Creek (Tons/Year/Square Mile)	Estimated Sediment Yield Canyon Creek (Tons/Year/Square Mile)	Average Sediment Yield Ninemile and Canyon (Tons/Year/Square Mile)	Average Sediment Yield Ninemile and Canyon Creeks (Tons/Year)	Estimated Sediment Yield Big Creek (Tons/Year)
Fines	14	37	25	850	760
Sand	11	23	17	560	500
Bedload	10	2	6	200	180
Total	34	62	48	1600	1400

4.0 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination and mass loading in the four segments of the Big Creek watershed are discussed in this section. Section 4.1 describes chemical concentrations found in environmental media, including horizontal and vertical extent. For each watershed segment, the discussion includes remedial investigation data chemical analysis results; comparison of chemical results to selected screening levels; and focused analysis of source areas. In Section 4.2, preliminary estimates of mass loading are presented.

4.1 NATURE AND EXTENT

The nature and extent of the ten metals of potential concern identified in Part 1, Section 5.1 (antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, silver, and zinc) in surface soil, subsurface soil, sediment, and surface water are discussed in this section. Groundwater samples were not collected as part of this investigation. Locations with metals detected in any matrix at concentrations 1 times (1x), 10 times (10x) and 100 times (100x) the screening level were identified and presented in data summary tables. The magnitudes of exceedance (10x and 100x) were arbitrarily selected to delineate areas of contamination.

Historical and recent investigations at areas within the study area are listed and summarized in Part 1, Section 4.0. Data source references are included as Attachment 1. Chemical data collected in Big Creek and used in this evaluation are presented in Attachment 2. Data summary tables include sampling location, data source reference, collection date, depth, and reported concentration. Screening level exceedances are highlighted. Sampling locations are shown on Figures 4.1-1 through 4.1-7.

The nature and extent of contamination were evaluated by screening chemical results against applicable risk-based screening criteria and available background concentrations. Screening levels are used in this analysis to identify source areas and media (e.g., soil, sediment, and surface water) of concern that will be evaluated in the Feasibility Study.

Statistical summaries for each metal in surface soil, subsurface soil, sediment, and surface water are included as Attachment 3 and discussed in the subsections below. The summaries include the number of samples analyzed; the number of detections; the minimum and maximum detected concentrations; the average and coefficient of variation; and the screening level (SL) to which the detected concentration is compared. Proposed screening levels were compiled from available federal numeric criteria (e.g., National Ambient Water Quality Criteria), regional preliminary remediation goals (PRGs) (e.g., U.S. EPA Region IX PRGs), regional baseline or background studies for soil, sediment, and surface water, and other guidance documents (e.g., National Oceanographic and Atmospheric Administration freshwater sediment screening values). The screening level selection process is discussed in detail in Part 1, Section 5.1.

Source areas within Big Creek are presented in Tables 4.1-1 through 4.1-4. These sites are based on source areas initially identified by the BLM (1999) and further refined during the RI/FS process. The tables include source area names, source ID, source area acres, description, number of samples by matrix type, and metals exceeding 1x, 10x and 100x the screening levels in surface soil, subsurface soil, sediment, and surface water.

It should be noted that the number of samples identified for each source area was determined using the project Geographical Information System. Only sampling locations located within a source area polygon (shown on Figures 4.1-1 through 4.1-7) are included in Tables 4.1-1 through 4.1-4; therefore, there may be samples collected from source areas and listed in the data summary tables in Attachment 2 that are not accounted for in Tables 4.1-1 through 4.1-4.

The following sections present segment-specific sampling efforts and results according to matrix type. Given the extensive geographic range of the Coeur d'Alene Basin, sampling efforts were focused on areas of potential concern; therefore, more samples were collected from known mining-impacted areas near the creek, than from other areas within the watershed.

4.1.1 Segment BigCrkSeg01

4.1.1.1 Surface Soil

Two surface soil samples were collected and analyzed for total metals in segment BigCrkSeg01. Concentrations for both sampling locations were less than 10x the screening levels.

4.1.1.2 Surface Water

Three surface water samples were collected and analyzed for total and dissolved metals in segment BigCrkSeg01. Concentrations were less than 10x the screening levels.

4.1.1.3 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, and surface water were reviewed together to identify source areas within segment BigCrkSeg01 that may be significant contributors of metals to Big Creek. Summary source area data are presented in Table 4.1-1. Two of the nine source areas in this segment were sampled for surface soil. Chemical concentrations at the source area sampling locations were all less than 10x the screening levels.

4.1.2 Segment BigCrkSeg02

4.1.2.1 Surface Water

Three surface water samples were collected and analyzed for total and dissolved metals within segment BigCrkSeg02. Results indicate concentrations greater than 10x the screening level for dissolved cadmium.

4.1.2.2 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, and surface water were reviewed together to identify source areas within segment BigCrkSeg02 that may be significant contributors of metals to Big Creek. Summary source area data are presented in Table 4.1-2. One of the eighteen source areas in this segment was sampled for surface water. Metals concentrations were less than 10x the screening level.

4.1.3 Segment BigCrkSeg03

4.1.3.1 Surface Soil

Two surface soil samples were collected from a depth of 0 to 0.5 feet and analyzed for total metals. Surface soil concentrations were all below screening levels for segment BigCrkSeg03.

4.1.3.2 Surface Water

Six surface water samples were collected and analyzed in segment BigCrkSeg03 for total and dissolved metals. All measured concentrations were less than 10x the screening levels.

4.1.3.3 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, and surface water were reviewed together to identify source areas within segment BigCrkSeg03 that may be significant contributors of metals to Big Creek. Summary source area data are presented in Table 4.1-3. Two of the eight source areas in this segment were sampled for surface water and three were sampled for surface soil. Metals concentrations for identified source areas were less than 10x the screening level.

4.1.4 Segment BigCrkSeg04

4.1.4.1 Surface Soil

Three surface soil samples were collected from a depth of 0 to 0.5 feet and analyzed for total metals. All samples were less than 10x the screening levels.

4.1.4.2 Sediment

One sediment sample within segment BigCrkSeg04 was collected and analyzed for total metals. Lead was detected at a concentration greater than 10x the screening level and antimony at greater than 100x the screening level.

4.1.4.3 Surface Water

Eleven surface water samples for total metals and nine for dissolved metals were collected and analyzed in segment BigCrkSeg04. Samples were collected during multiple sampling events dating from 1991 to 1999. Manganese was detected at concentrations that exceeded 100x the screening level for total metals. Manganese was detected at a concentration for dissolved metals that exceeded 100x the screening level.

4.1.4.4 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, groundwater, and surface water were reviewed together to identify source areas within segment BigCrkSeg04 that may be significant contributors of metals to Big Creek. Summary source area data are presented in Table 4.1-4. Two of the 33 source areas in this segment were sampled for surface soil and one was sampled for surface water. Total manganese in surface water from the First National Mine exceeded 10x the screening level.

4.1.5 Adit and Seep Summary

Most adits and seeps with drainage that have been identified and sampled have flows under 1 cfs and relatively low concentrations of metals (Gearheart et al. 1999). Seven adits were identified. Seeps were not identified in this watershed. Available adit data for Big Creek are summarized in Table 4.1.5-1. Discharge, average total zinc concentration, and average total zinc mass loading, and associated source areas are listed. Total zinc mass loading for all adits identified in Big Creek is estimated to be less than 1 pound per day.

4.2 SURFACE WATER MASS LOADING

In Part 1 of this report, (Setting and Methodology, Section 5.3.1), the concept of mass loading and its use in the remedial investigation was presented. Section 4.2 of the Canyon Creek Nature and Extent further discussed the use of plotting discrete sampling events versus the probabilistic analysis of the mass loading data in Fate and Transport.

The Big Creek Watershed has very limited data by which to assess mass loading in surface water or groundwater. As summarized in Table 4.2-1, there are two in-stream data points for which total lead mass loading can be calculated. There are two in-stream data points for which dissolved zinc mass loading can be calculated.

A review of the lead loading data indicates that with a 2.4-fold increase in flow there is a 40-fold increase in total lead mass loading. The 1999 sampling event was at a higher flow than any previous event. The data were collected by the USGS (USGS 2000) and are believed to be accurate. There was no similar increase between the two dissolved zinc loading measurements.

The potential source of the increased lead loading could be the Sunshine tailings and mine ponds located in the lower portion of the Big Creek Watershed. As discussed in fate and transport sections of other watersheds and by McBain and Trush (2000), there is a disproportionate increase in lead loading at very high flows. The lead loading observed in Big Creek may indicate the presence of a source larger than the previous data would have indicated. Therefore, mass loading in Big Creek has not been sufficiently characterized and is considered a data gap.

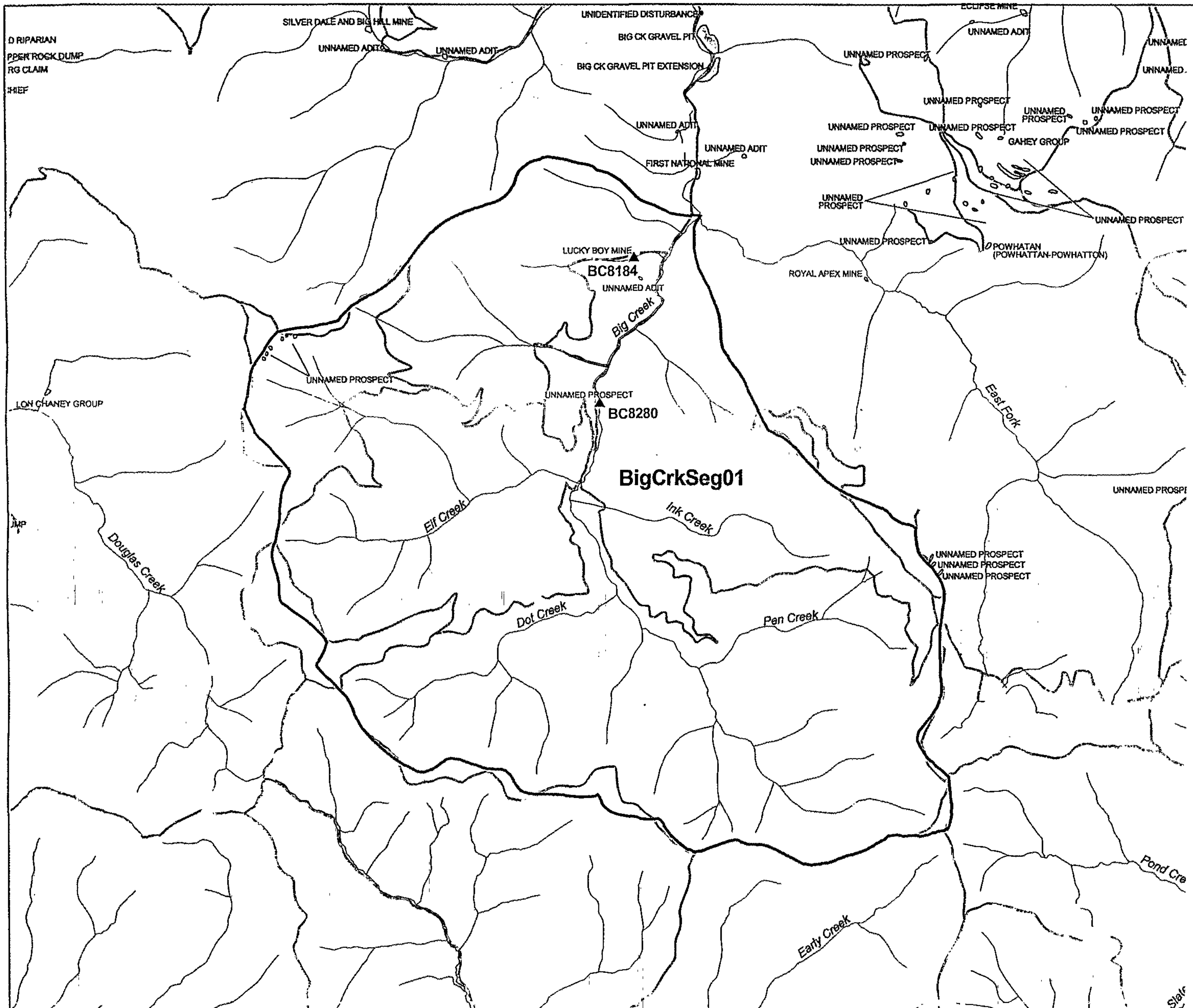


Figure 4.1-1
Big Creek Segment BigCrkSeg01 Source Areas and Soil/Sediment Sampling Locations

LEGEND

- ▲ Tailings Sampling Location
- Stream
- Road
- ★ City
- Big Creek Segment 1
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:36,000

0 0.5 1 Miles

027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA REGION 10

Doc Control 4162500.6515.05a
Generation 1
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V: BigCkSeg01 Soil
E:soil
L: Final RI BigCkSeg01 soil
7/13/2001

This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 13, 2001

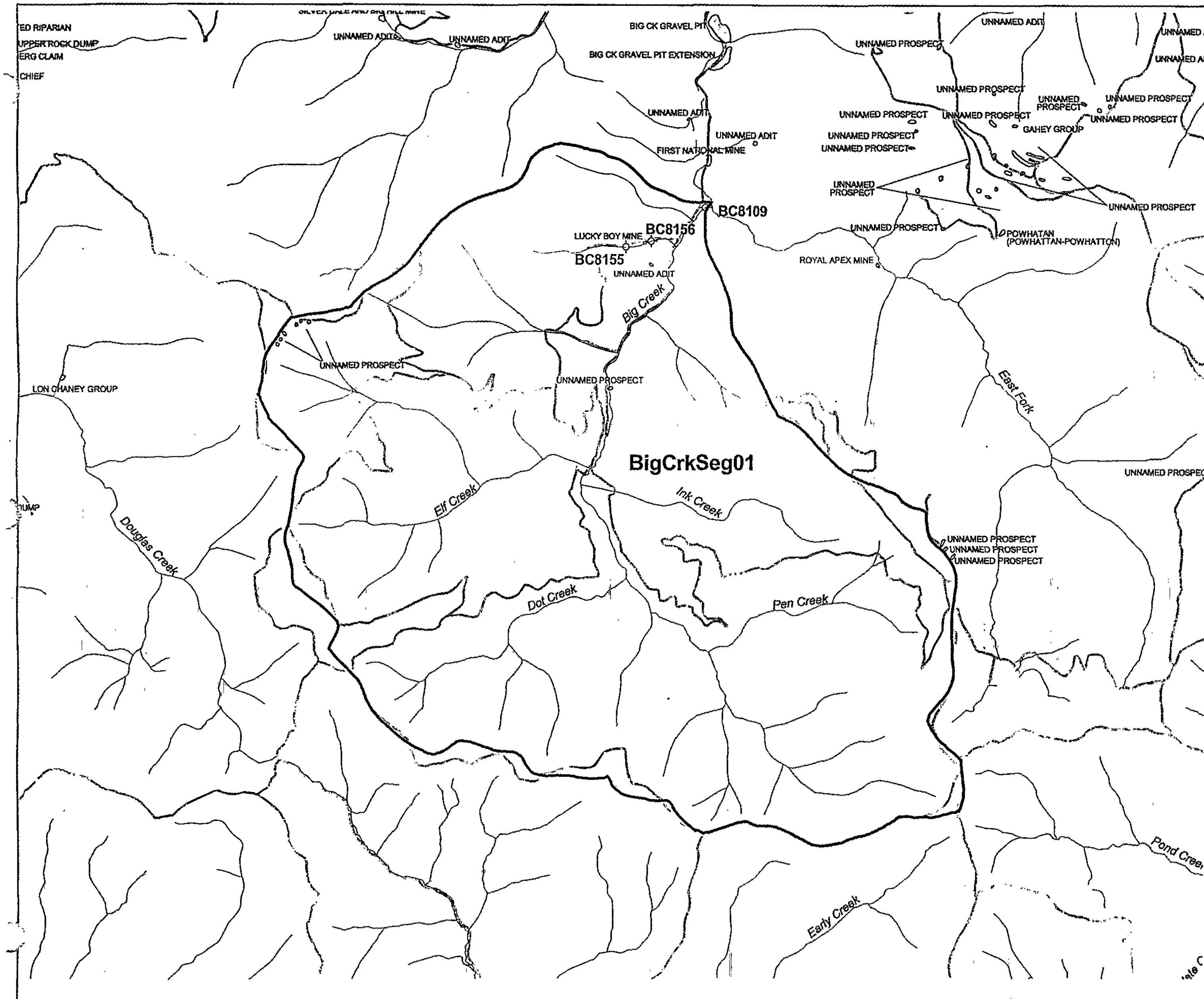

Figure 4.1-2
Big Creek Segment BigCrkSeg01 Source Areas and Surface Water Sampling Locations

LEGEND

- River Sampling Location
- Stream
- Road
- City
- Big Creek Segment 1
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:36,000

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027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

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REGION 10

Document Control 4162500.6615.05.a
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V: BigCkSeg01 SW
E:surface water
L: Final RI BigCkSeg01 SW
7/13/2001

This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 13, 2001

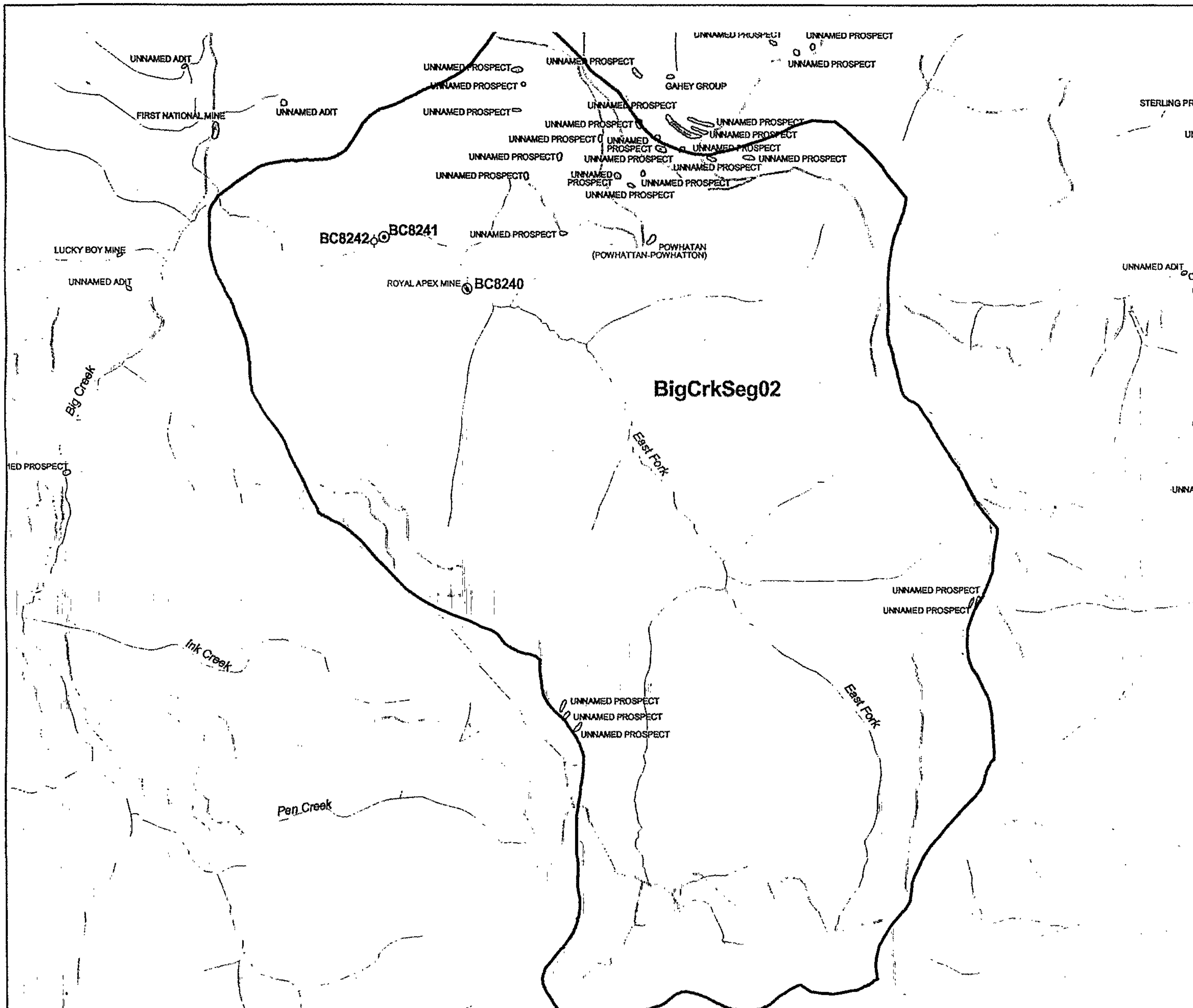

Figure 4.1-3
Big Creek Segment BigCrkSeg02
Source Areas and Surface Water Sampling Locations

LEGEND
- Adit Sampling Location
- River Sampling Location
- Stream
- Road
- City
- Big Creek Segment 2
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:24,000

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N

027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA
REGION 10

Doc Control 4162500.8615.05a
Generation 1
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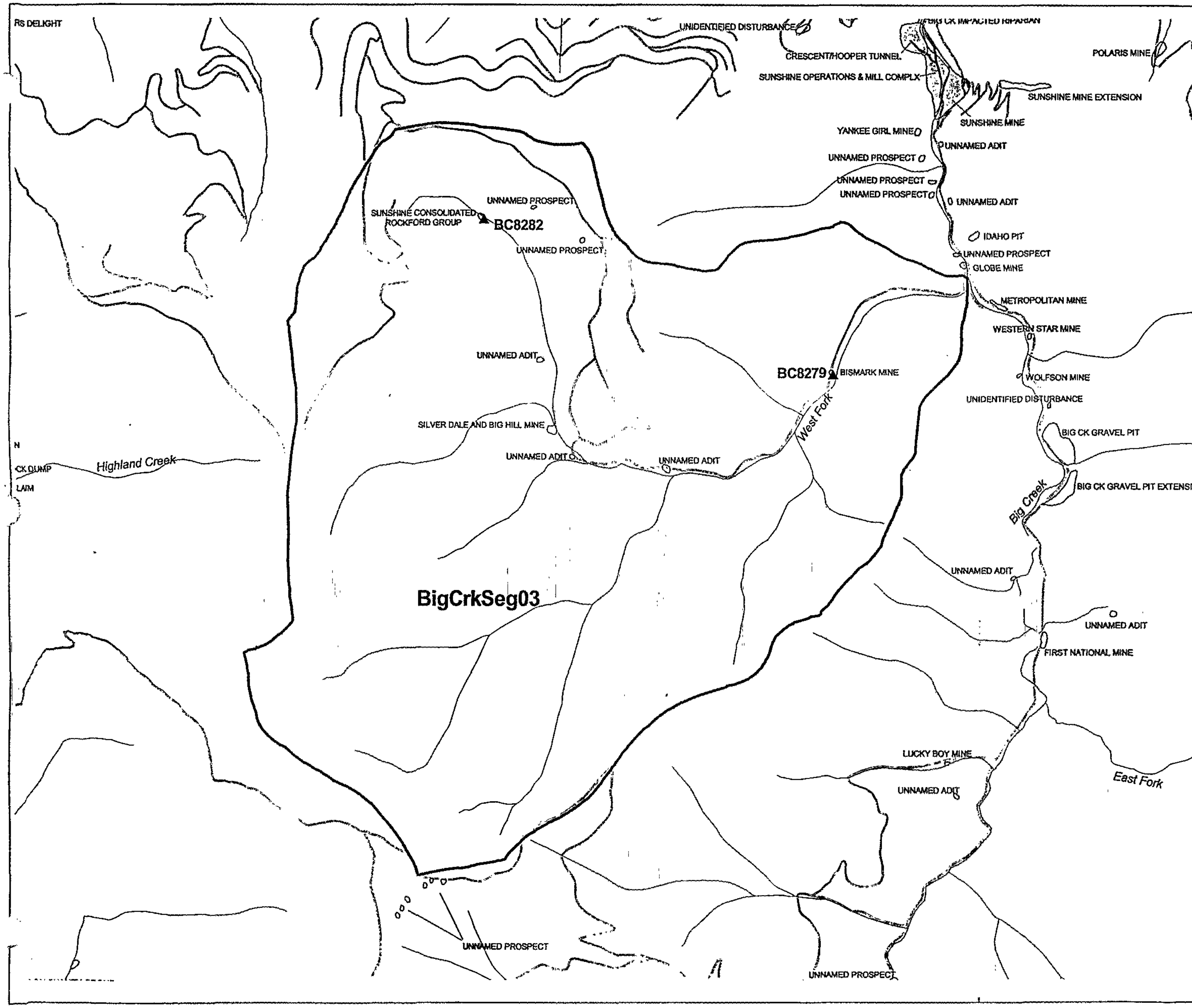
V: BigCkSeg02 SW
E: surfacewater
L: Final RI BigCkSeg02 SW
7/13/2001

This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

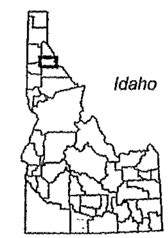
Date of Plot: July 13, 2001

Figure 4.1-4
Big Creek Segment BigCrkSeg03 Source Areas and Soil/Sediment Sampling Locations



LEGEND

- ▲ Tailings Sampling Location
- Stream
- Road
- ★ City
- Big Creek Segment 3
- Source Area and Name



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:24,000

0 — 0.5 Miles

N

027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA
REGION 10

Document Control 4162500.6615.05.a
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V: BigCkSeg03 Soil
Esoil
L: Final RI BigCrkSeg03 Soil
7/13/2001

This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 13, 2001

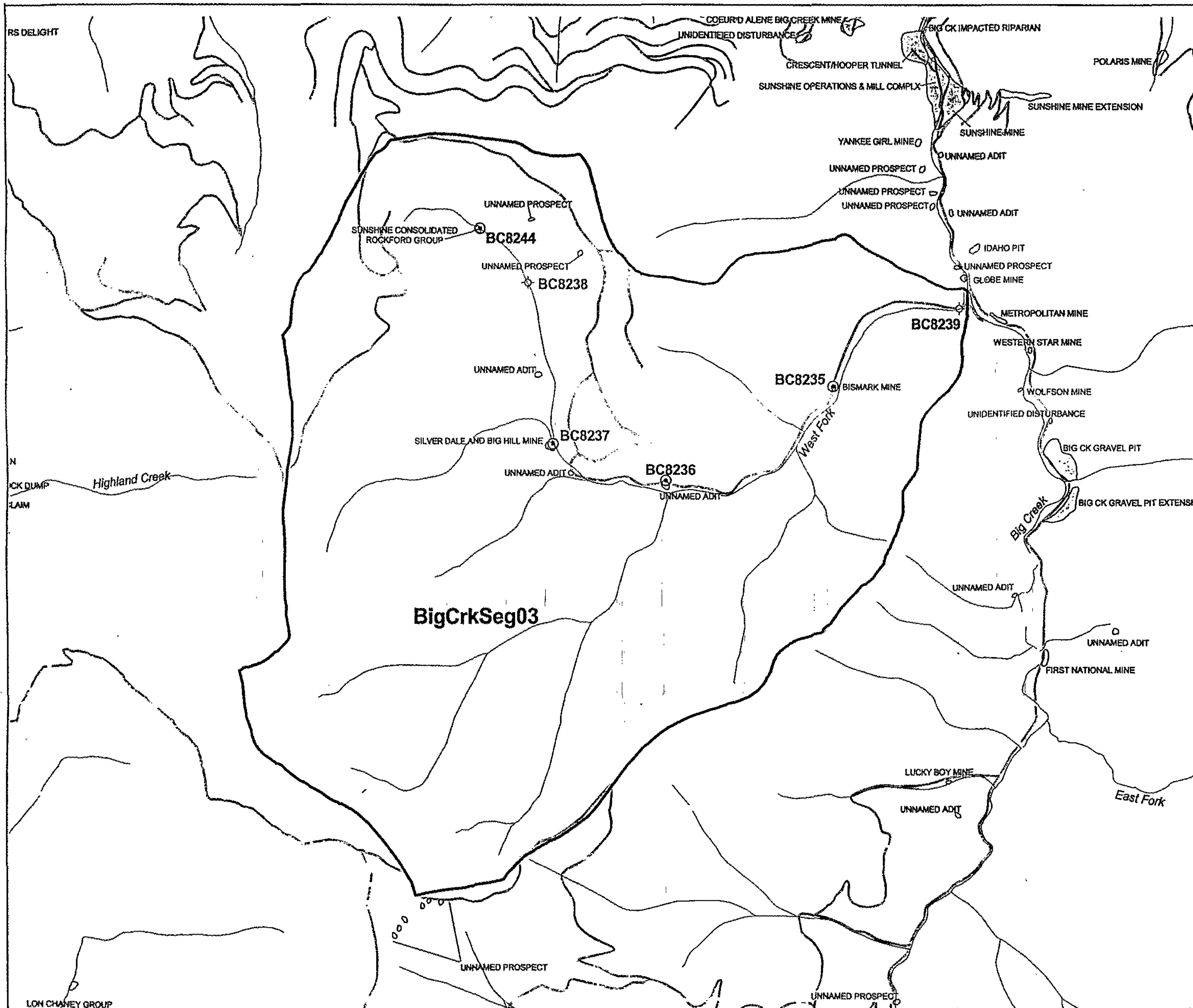

Figure 4.1-5
Big Creek Segment BigCrkSeg03 Source Areas and Surface Water Sampling Locations

LEGEND

- Adit Sampling Location
- River Sampling Location
- Stream
- Road
- City
- Big Creek Segment 3
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:24,000

0 0.5 Miles

N

027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA
REGION 10

Doc Control 4162500.6615.05a
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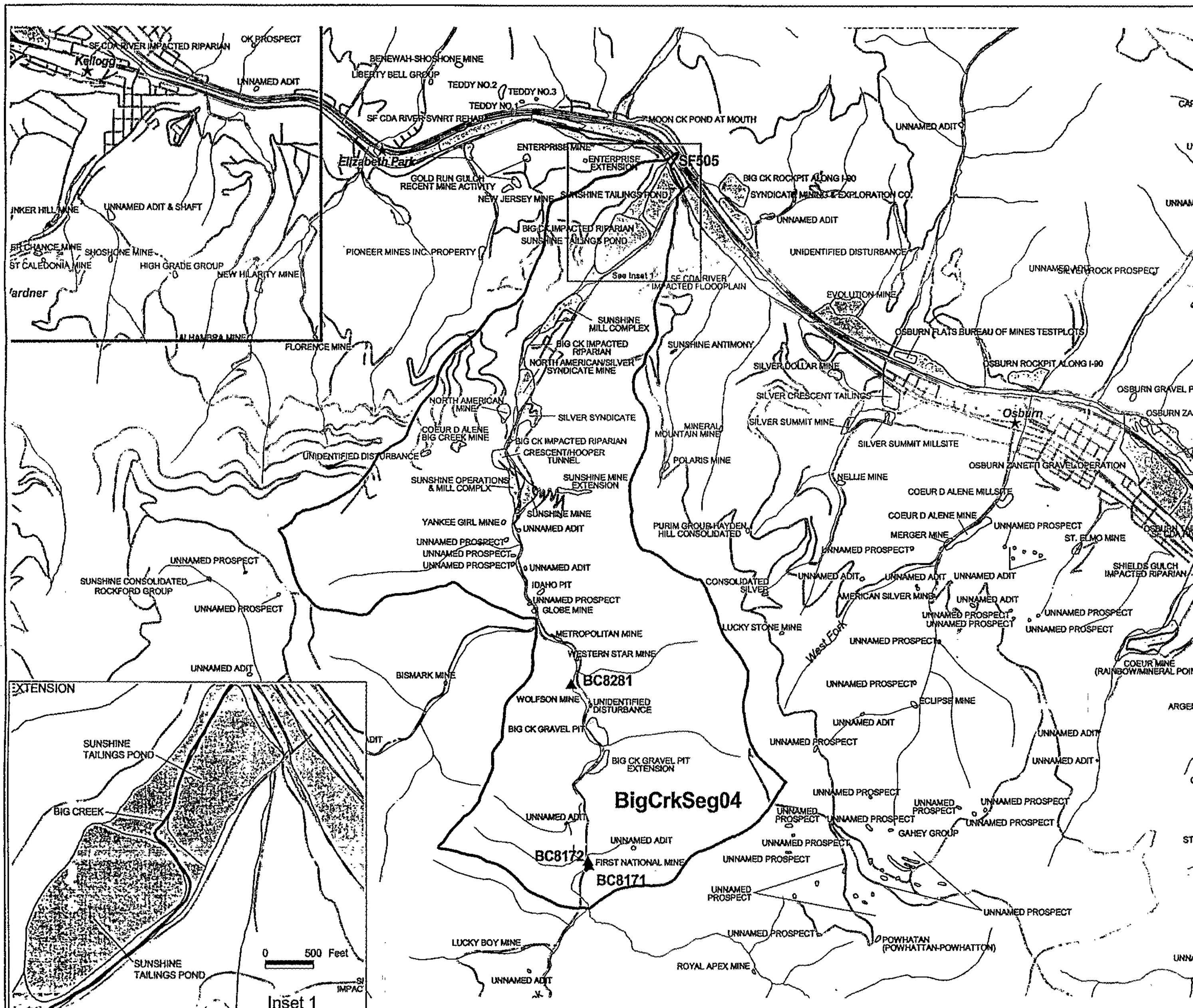
V: BigCrkSeg03 SW
E:surface water
L: Final RI BigCrkSeg03 SW
7/13/2001

This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 13, 2001

Figure 4.1-6
Big Creek Segment BigCrkSeg04 Source Areas and Soil/Sediment Sampling Locations



LEGEND

- ▲ Tailings Sampling Location
- ◇ Hand Auger Sampling Location
- Stream
- Road
- ★ City
- Big Creek Segment 4
- Source Area and Name
- Bunker Hill Box

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:36,000

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027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA REGION 10

Document Control 4162500.6515.05.a
Generation 1
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V: BigCrkSeg04 Soil
E:soil
L: Final RI BigCrkSeg04 Soil
7/15/01

This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 15, 2001

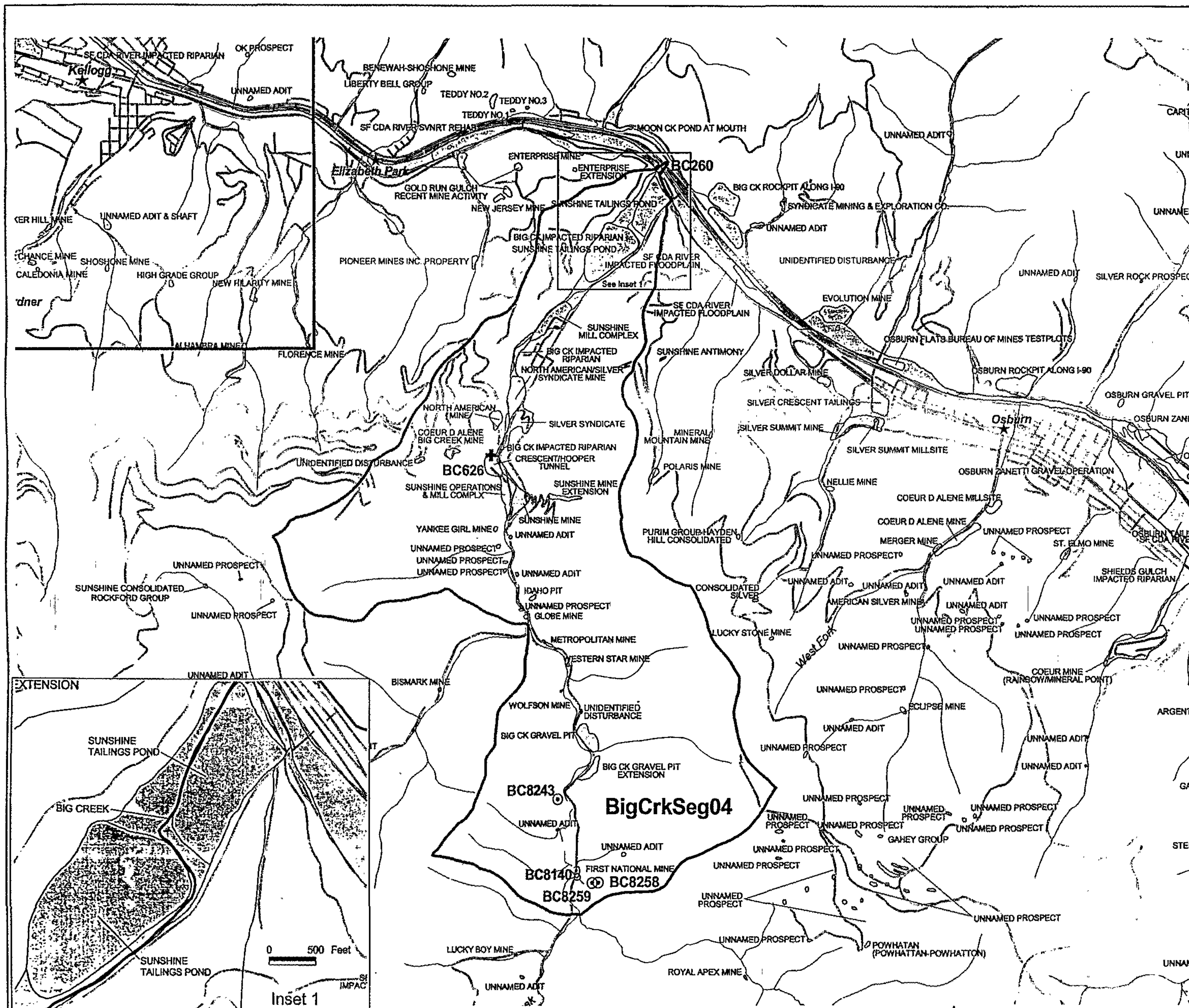

Figure 4.1-7
Big Creek Segment BigCrkSeg04 Source Areas and Surface Water Sampling Locations

LEGEND

- Adit Sampling Location
- River Sampling Location
- Outfall Sampling Location
- Seep Sampling Location
- Stream
- Road
- City
- Big Creek Segment 4
- Source Area and Name
- Bunker Hill Box

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:36,000

0 0.5 1 Miles

N

027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA REGION 10

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V: BigCrkSeg04 SW
E: surface water
L: BigCrkSeg04 SW
7/14/01

This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 15, 2001

Table 4.1-1
Potential Source Areas Within Big Creek - segment BigCrkSeg01

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type		Metals > 1X	Metals > 10X	Metals > 100X
LUCKY BOY MINE	POL052	0.14	Floodplain waste rock	SL	1	SST: As-1		
UNNAMED ADIT	POL051	0.20	Upland waste rock					
UNNAMED PROSPECT	POL044	0.30	Upland waste rock (erosion potential)	SL	1	SST: As-1, Pb-1, Zn-1		
UNNAMED PROSPECT	POL045	0.19	Upland waste rock					
UNNAMED PROSPECT	POL046	0.18	Upland waste rock					
UNNAMED PROSPECT	POL047	0.22	Upland waste rock					
UNNAMED PROSPECT	POL048	0.17	Upland waste rock					
UNNAMED PROSPECT	POL049	0.13	Upland waste rock					
UNNAMED PROSPECT	POL050	0.22	Upland waste rock					

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.1-2
Potential Source Areas Within Big Creek - segment BigCrkSeg02

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type		Metals > 1X	Metals > 10X	Metals > 100X
POWHATAN (POWHATTAN-POWHATTON)	POL040	0.47	Upland waste rock					
ROYAL APEX MINE	POL024	0.20	Upland waste rock	SW	1	SWT: Cd-1		
UNNAMED PROSPECT	POL025	0.27	Upland waste rock					
UNNAMED PROSPECT	POL026	0.23	Upland waste rock					
UNNAMED PROSPECT	POL027	0.47	Upland waste rock					
UNNAMED PROSPECT	POL028	0.13	Upland waste rock					
UNNAMED PROSPECT	POL036	0.51	Upland waste rock					
UNNAMED PROSPECT	POL037	0.28	Upland waste rock					
UNNAMED PROSPECT	POL038	0.17	Upland waste rock					
UNNAMED PROSPECT	POL039	0.21	Upland waste rock					
UNNAMED PROSPECT	POL041	0.37	Upland waste rock					
UNNAMED PROSPECT	POL042	0.34	Upland waste rock					
UNNAMED PROSPECT	POL043	0.35	Upland waste rock					
UNNAMED PROSPECT	POL053	0.25	Upland waste rock					
UNNAMED PROSPECT	POL054	0.30	Upland waste rock					
UNNAMED PROSPECT	POL056	0.42	Upland waste rock					
UNNAMED PROSPECT	POL062	0.32	Upland waste rock					
UNNAMED PROSPECT	POL063	0.22	Upland waste rock					

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.1-3
Potential Source Areas Within Big Creek - segment BigCrkSeg03

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
BISMARK MINE	POL004	0.21	Adit drainage Adit drainage Upland waste rock	SL 1 SW 1	SWT: Cd-1		
SILVER DALE AND BIG HILL MINE	POL002	0.68	Adit drainage Floodplain waste rock	SW 1	SWT: Cd-1		
SUNSHINE CONSOLIDATED ROCKFORD GROUP	POL001	0.34	Floodplain waste rock	SL 1 SW 1	SWT: Fe-1		
UNNAMED ADIT	POL067	0.49	Adit drainage Upland waste rock				
UNNAMED ADIT	POL068	0.20	Upland waste rock (erosion potential)				
UNNAMED ADIT	POL069	0.29	Upland waste rock				
UNNAMED PROSPECT	POL070	0.21	Upland waste rock				
UNNAMED PROSPECT	POL071	0.14	Upland waste rock				

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.1-4
Potential Source Areas Within Big Creek - segment BigCrkSeg04

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type	Metals > 1X	Metals > 10X	Metals > 100X
BIG CK GRAVEL PIT	POL013	7.83	Floodplain waste rock				
BIG CK GRAVEL PIT EXTENSION	POL014	4.00	Upland waste rock				
BIG CK IMPACTED RIPARIAN: NO. 1	KLE047	1.19	Floodplain sediments				
BIG CK IMPACTED RIPARIAN: NO. 2	KLE073	5.81	Floodplain sediments				
BIG CK IMPACTED RIPARIAN: NO. 3	KLE071	31.32	Floodplain sediments				
COEUR D ALENE BIG CREEK MINE	KLE029	2.22	Upland waste rock				
CRESCENT/HOOPER TUNNEL	KLE054	6.67	Adit drainage Upland waste rock (erosion potential)				
FIRST NATIONAL MINE	POL022	0.85	Adit drainage Floodplain waste rock	SL 2 SW 1	SST: As-1 SWD: Cu-1 SWT: Cd-1, Fe-1	SWT: Mn-1	
GLOBE MINE	POL008	0.34	Floodplain waste rock				
IDAHO PIT	POL007	0.59	Upland waste rock				
METROPOLITAN MINE	POL009	0.61	Upland waste rock				
NORTH AMERICAN MINE	KLE027	3.88	Upland waste rock (erosion potential)				
NORTH AMERICAN/SILVER SYNDICATE MINE	KLE053	12.19	Floodplain waste rock				
SILVER SYNDICATE	KLE026	12.20	Floodplain waste rock				
SUNSHINE MILL COMPLEX	KLE072	15.11	Upland tailings				
SUNSHINE MINE	KLE030	8.34	Floodplain waste rock				
SUNSHINE MINE EXTENSION	KLE031	2.86	Upland waste rock				
SUNSHINE OPERATIONS & MILL COMPLX	KLE055	10.69	Upland tailings				
SUNSHINE TAILINGS POND: NO. 1	KLE024	42.26	Floodplain sediments (underlying tailings pond) Floodplain tailings Groundwater				
SUNSHINE TAILINGS POND: NO. 2	KLE025	24.12	Floodplain sediments Floodplain tailings				
UNIDENTIFIED DISTURBANCE	KLE028	0.94	Upland waste rock				
UNIDENTIFIED DISTURBANCE	POL012	0.14	Upland waste rock				
UNNAMED ADIT	POL006	0.19	Upland waste rock				
UNNAMED ADIT	POL023	0.30	Upland waste rock				
UNNAMED ADIT	POL066	0.15	Upland waste rock (erosion potential)				
UNNAMED ADIT	POL075	0.20	Upland waste rock				
UNNAMED PROSPECT	POL072	0.29	Upland waste rock				
UNNAMED PROSPECT	POL073	0.24	Upland waste rock				

Table 4.1-4
Potential Source Areas Within Big Creek - segment BigCrkSeg04

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type		Metals > 1X	Metals > 10X	Metals > 100X
UNNAMED PROSPECT	POL074	0.24	Upland waste rock					
UNNAMED PROSPECT	POL076	0.23	Upland waste rock					
WESTERN STAR MINE	POL010	0.19	Upland waste rock (erosion potential)					
WOLFSON MINE	POL011	0.13	Floodplain waste rock	SL	1			
YANKEE GIRL MINE	POL005	0.34	Upland waste rock					

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.1.5-1
Adit Data Summary

BLM ID	Source Name	Average Discharge (cfs)	Maximum Discharge (cfs)	Average Total Zinc Concentration (µg/L)	Average Total Zinc Load (lbs/day)
KLE054	Hooper Tunnel	0.1	0.082	190	0.10
POL002	Silver Dale and Big Hill	0.0156	0.0156	3	0.00025
POL004	Bismarck	0.0112	0.0112	3	0.00018
POL022	First National	0.001	0.001	4	0.000022
POL067	Unnamed adit	No data	No data	10	No discharge data
POL001	Sunshine Cons.-Rockford Group	No data	No data	No data	No data
POL024	Royal Apex	No data	No data	No data	No data

Notes:
Data compiled from the Restorations Alternative Plan (Gearheart et al. 1999). See Appendix J.
cfs - cubic feet per second
µg/L - micrograms per liter
lbs/day - pounds per day

Table 4.2-1
Mass Loading Big Creek

Location	Sample No.	Big Creek Segment	Sample Type	Sample Date	Flow CFS	Total Lead		Dissolved Zinc	
						Conc. µg/L	Load lbs/day	Conc. µg/L	Load lbs/day
BC8109	-	1	RV	01-Jan-97	-	-	-	2.5 U	-
BC8155	-	1	RV	01-Jan-97	-	15 U	-	2.5	-
BC8156	-	1	RV	01-Jan-97	-	15 U	-	2.5U	-
BC8242	-	2	RV	01-Jan-97	-	15 U	-	4	-
BC8238	-	3	RV	01-Jan-97	-	15 U	-	2.5 U	-
BC8239	-	3	RV	01-Jan-97	-	15 U	-	2.5 U	-
BC260	168463	4	RV	05-Nov-97	24.1	0.33 U		6.93	1
BC260	172068	4	RV	14-May-91	211.3	3 U		20 U	
BC260	172103	4	RV	01-Oct-91	5.61	1 U		12 U	
BC260	186944	4	RV	25-May-99	604	28	91	1.4	5
BC260	46351	4	RV	09-May-98	254	1.7	2	5 U	

Notes:
CFS: Cubic feet per Second
lbs/day: pounds per day
µg/L: Micrograms per liter
RV: River Sample
U: Not detected at concentration greater than or equal to the associated value
- : Data not available or mass load not calculated

5.0 FATE AND TRANSPORT

The fate and transport of metals in surface water and sediment in the Big Creek Watershed are discussed in this section. Groundwater data were not available for this watershed. A conceptual model of fate and transport, important fate and transport mechanisms, and a summary of the probabilistic model developed to evaluate fate and transport, were presented in the fate and transport section in the Canyon Creek report and are not repeated here. Due to limited available surface water data for the Big Creek Watershed, the probabilistic model was not used to estimate expected values for discharge, metals concentrations or mass loading. Instead, measured values for these parameters were evaluated and results are presented in this section. Additionally, sediment data are not available for the floodplain and Sunshine mine tailings ponds located in segment BigCrkSeg04, a likely source of metals-impacted sediment to Big Creek and the South Fork; therefore, potential impacts from these source areas could not be evaluated.

5.1 SUMMARY OF MEASURED CONCENTRATIONS AND MASS LOADING RESULTS

Segment BigCrkSeg01 contains the headwaters of Big Creek down to just below the First National mine. The BLM identified nine source areas in this segment, mostly unnamed prospects but including the Lucky Boy Mine. Sampling of three surface water locations in this segment indicates that metals concentrations are slightly greater than ambient water quality criteria (AWQC). Sediment samples were not collected from this segment.

Segment BigCrkSeg02 contains the headwaters of the East Fork of Big Creek to its confluence with the main stem of Big Creek. The BLM identified 21 source areas in this segment. These areas are mostly unnamed prospects in areas distant from the stream. The Royal Apex Mine is located adjacent to Big Creek in this segment. Sampling of three surface water locations indicates that metals concentrations in surface water are slightly greater than AWQC. Soil and sediment samples were not collected from this segment.

Segment BigCrkSeg03 contains the headwaters of the West Fork of Big Creek down to its confluence with the main stem of Big Creek. The BLM identified eight source areas in this segment. Sampling of six surface water locations indicates that metals concentrations in surface water are slightly greater than AWQC. Sediment samples were not collected from this segment.

Segment BigCrkSeg04 begins at the confluence of the main stem of Big Creek with the East Fork and ends at the confluence of Big Creek with the South Fork Coeur d'Alene River. The BLM identified 33 source areas in this segment. Sampling of six surface water locations indicates that metals concentrations in surface water are greater than AWQC. Metals concentrations in one sediment sample collected from the floodplain downgradient from the Sunshine Tailings pond at the confluence of Big Creek with the South Fork exceeded screening levels. Sediment samples were not collected from these tailings ponds or from other areas of the floodplain in this segment; therefore, potential impacts from these source areas could not be evaluated.

Preliminary mass loading estimates were discussed in Section 4.2. The lowest and highest dissolved cadmium, lead and zinc and total lead loadings calculated from surface water metals data for sampling location BC260, located at the mouth of Big Creek, for five sampling events (May, 1991; October, 1991; November, 1997; May, 1998; and May, 1999) are listed in Table 5.1-1.

As presented in Section 4.2 and Table 5.1-1, estimates of mass loading, which are based on a very limited data set, show small but significant contributions of metals from Big Creek to the South Fork. As shown in the May 1999 high-flow sampling event, the USGS (2000) estimated that 91.1 pounds/day of total lead were contributed by Big Creek to the South Fork at sampling location BC260.

5.2 SUMMARY OF SEDIMENT FATE AND TRANSPORT

Sediment fate and transport processes were presented in Section 3.0. Results of the sediment transport evaluation presented in Section 3.0 are summarized in this section.

Big Creek enters the South Fork approximately 3 miles upstream of Kellogg, Idaho. Sediment derived in Big Creek is transported to the South Fork. The Big Creek Watershed has a drainage area of approximately 29.9 square miles with approximately 10.9 miles of mapped channel length. The BLM identified 71 potential source areas in the Big Creek Watershed. Based on review of aerial photographs, sediment sources in Big Creek are mobilization of channel bed sediment, bank erosion, and rock debris and tailings piles situated adjacent to channels.

Because no sediment transport data were collected for Big Creek, estimates of sediment transport for 1999 were made using the sediment transport analysis from Canyon and Ninemile Creeks. Estimated total suspended and bedload sediment yield for Big Creek to the South Fork is approximately 1,440 tons/year. Of that, approximately 53 percent is fines, 35 percent is sand, and 12 percent is bedload. These estimates likely overestimate the amount of sediment transport because far fewer discrete sources exist in the Big Creek Watershed than in the Canyon and Ninemile Creek Watersheds. Suspended and bedload sediment samples were not collected and analyzed for metals. Insufficient data were collected on surface soil and sediment samples from which to estimate suspended and bedload sediment concentrations.

5.3 SUMMARY OF FATE AND TRANSPORT

Preliminary evaluations of metals sources in Big Creek and subsequent transport to the South Fork were presented above. Based on an extremely limited data set, it appears that Big Creek may be contributing significant amounts of metals to the South Fork. A primary source of these metals may be the Sunshine Mine and Mill Complex and its associated tailings piles. Surface soil, sediment and surface water samples were not collected from these potential sources; therefore, impacts from these areas could not be evaluated.

Table 5.1-1
Low and High Instantaneous Metal Loading Values for Sampling Location BC260

Metal	Low (pounds/day)	High (pounds/day)
Dissolved Cadmium	Not detected	0.03
Total Lead	1.7	91.1
Dissolved Lead	1.31	2.33
Dissolved Zinc	0.9	4.7

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ATTACHMENT 1
Data Source References

Data Source References

Data Source References[a]	Data Source Name	Data Source Description	Reference
2	URS FSPA Nos. 1, 2, and 3	Fall 1997: Low Flow and Sediment Sampling	URS Greiner Inc. 1997. Field Sampling Plan Addendum 1 Sediment Coring in the Lower Coeur d'Alene River Basin, Including Lateral Lakes and River Floodplains
			URS Greiner Inc. 1997. Field Sampling Plan Addendum 2 Adit Drainage, Seep and Creek Surface Water Sampling
			URS Greiner Inc. 1997. Field Sampling Plan Addendum 3 Sediment Sampling Survey in the South Fork of the Coeur d'Alene River, Canyon Creek, and Nine-Mile Creek
3	URS FSPA No. 4	Spring 1998: High Flow Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 4 Adit Drainage, Seep and Creek Surface Water Sampling; Spring 1998 High Flow Event
4	MFG Historical Data Spring 1991	Spring 1991: High Flow Sampling	McCulley, Frick & Gillman, Inc. 1991. Upstream Surface Water Sampling Program Spring 1991 High Flow Event, South Fork Coeur d'Alene River Basin above Bunker Hill Superfund Site: Tables 1 and 2
5	MFG Historical Data Fall 1991	Fall 1991: Low Flow Sampling	McCulley, Frick & Gillman, Inc. 1992. Upstream Surface Water Sampling Program Fall 1991 Low Flow Event, South Fork Coeur d'Alene River Basin above Bunker Hill Superfund Site: Tables 1 and 2
6	EPA/Box Historical Data	Superfund Site Groundwater and Surface Water Data	CH2MHill. 1997. Location of Wells and Surface Water Sites, Bunker Hill Superfund Site. Fax Transmission of Map August 11, 1998
			Environmental Protection Agency. 1998. E-mail from Ben Cope July 15, 1998. Subject: 2 Datasets File Attached: BOXDATA.WK4
7	IDEQ Historical Data	IDEQ Water Quality Data	Idaho Department of Environmental Quality. 1998. Assortment of files from Glen Pettit for water years 1993 through 1996
			Idaho Department of Environmental Quality. 1998. E-mail from Glen Pettit October 6, 1998 Subject: DEQ Water Quality Data Files Attached: 1998 trend Samples.xls, 1997 trend Samples.xls

Data Source References (Continued)

Data Source References	Data Source Name	Data Source Description	Reference
8	EPA/NPDES Historical Data	Water Quality based on NPDES Program	Environmental Protection Agency. 1998. E-mail from Ben Cope August 11, 1998/September 2, 1998. Subject: Better PCS Data Files/Smelterville. Attached: PCS2.WK4, PCSREQ.698/TMT-PLAN.XLS
			Environmental Protection Agency. 1998. E-mail from Ben Cope August 5, 1998. Subject: State of Idaho Lat/Longs File Attached: PAT.DBF
			Environmental Protection Agency. 1998. E-mail from Ben Cope July 15, 1998. Subject: 2 Datasets File Attached: PCSDATA.WK4
10	URS FSPA No. 5	Common Use Areas Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 5 Common Use Areas: Upland Common Use Areas and Lower Basin Recreational Beaches; Sediment/Soil, Surface Water, and Drinking Water Supply Characterization
11	URS FSPA No. 8	Source Area Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 8 Tier 2 Source Area Characterization Field Sampling Plan
12	Historical Groundwater Data from MFG	1997 Annual Groundwater Data Report Woodland Park	McCulley, Frick & Gillman. 1998. 1997 Annual Groundwater Data Report Woodland Park
13	Historical Data from US Forest Service, Idaho Geological Survey and others	Historical Data on Inactive Mine Sites USFS, IGS and CCJM, 1994-1997, Prichard Creek, Pine Creek and Summit Mining District	Mackey K, Yarbrough, S.L. 1995. Draft Removal Preliminary Assessment Report Pine Creek Millsites, Coeur d'Alene District, Idaho, Contract No. 1422-N651-C4-3049
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. I, Prichard Creek and Eagle Creek Drainages
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. III, Coeur d'Alene River Drainage Surrounding the Coeur d'Alene Mining District (Excluding the Prichard Creek and Eagle Creek Drainages)

Data Source References (Continued)

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13	Historical Data from US Forest Service, Idaho Geological Survey and others (continued)		Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. V, Coeur d'Alene River Drainage Surrounding the Coeur d'Alene Mining District (Excluding the Prichard Creek and Eagle Creek Drainages) Part 2 Secondary Properties
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15	URS FSPA No. 9	Source Area Characterization; Field XRF Data	CH2M Hill and URS Greiner. 1998. Field Sampling Plan Addendum 9 Delineation of Contaminant Source Areas in the Coeur d'Alene Basin using Survey and Hyperspectral Imaging Techniques
16	Historical Sediment Data	Electronic Data compiled by USGS	U.S. Geological Survey. 1992. Effect of Mining-Related Activities on the Sediment-Trace Element Geochemistry of Lake Coeue d'Alene, Idaho, USA--Part 1: Surface Sediments, USGS Open-File Report 92-109, Prepared by A.J. Horowitz, K.A. Elrick, and R.B. Cook
			US Geological Survey. 2000. Chemical Analyses of Metal-Enriched Sediments, Coeur d'Alene Drainage Basin, Idaho: Sampling, Analytical Methods, and Results. Draft. October 13, 2000. Prepared by S.E. Box, A.A. Bookstrom, M. Ikramuddin, and J. Lindsey. Samples collected from 1993 to 1998.

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
17	USGS Spokane River Basin Sediment Samples	Surface Sediment Samples Collected by USGS in the Spokane River Basin	Environmental Protection Agency. 1999. Data Validation Memorandum and Attached Table from Laura Castrilli to Mary Jane Nearman dated June 9, 1999. Subject: Coeur d'Alene (Bunker Hill) Spokane River Basin Surface Sample Samples, USGS Metals Analysis, <63 um fraction, Data Validation, Samples SRH7-SRH30
18	USGS Snomelt Surface Water Data	Surface Water Data from 1999 Snomelt Runoff Hydrograph	USGS. 1999. USGS WY99.xls Spreadsheet dowloaded from USGS (Coeur d'Alene Office) ftp site
			USGS. 2000. Concentrations and Loads of Cadmium, Lead and Zinc Measured near the Peak of the 1999 Snomelt Runoff Hydrograph at 42 Stations, Coeur d'Alene River Basin Idaho
			USGS. 2000. Concentrations and Loads of Cadmium, Lead and Zinc Measured on the Ascending and Descending Limbs of the 1999 Snomelt Runoff Hydrograph at Nine Stations, Coeur d'Alene River Basin Idaho
22	MFG Report on Union Pacific Railroad Right-of-Way Soil Sampling	Surface and Subsurface Soil Lead Data	MFG. 1997. Union Pacific Railroad Wallace Branch, Rails to Trails Conversion, Right-of-Way Soil Sampling, Summary and Interpretation of Data. McCulley, Frick and Gilman, Inc. March 14, 1997
23	URS FSPA No. 11A	Source Area Groundwater and Surface Water Sampling	URS Greiner Inc. 1999. Field Sampling Plan Addendum 11A Tier 2 Source Area Characterization
24	URS FSPA No. 15	Common Use Area Sampling—Spokane River	URS Greiner Inc. 1999. Field Sampling Plan Addendum 15 Spokane River - Washington State Common Use Area Sediment Characterization
25	URS FSPA No. 18	Depositional and Common Use Area Sediment Sampling - Spokane River	URS Greiner Inc. 2001. Final Field Sampling Plan Addendum No. 18, Fall 2000 Field Screening of Sediment in Spokane River Depositional Areas, Summary of Results. Revision 1. January 2001.

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
28	USGS National Water Quality Assessment database	Surface water data for sampling location NF50 at Enaville, Idaho.	USGS. 2001. USGS National Water Quality Assessment database: http://infotrek.er.usgs.gov/pls/nawqa/nawqa.wwv_main.gohome. Data retrieved on August 2, 2001 for station 12413000, NF Coeur d'Alene River at Enaville, Idaho.

[a]Reference Number is the sequential number used as cross reference to associate chemical results in data summary tables with specific data collection efforts.

ATTACHMENT 2
Data Summary Tables

ABBREVIATIONS USED IN DATA SUMMARY TABLE

LOCATION TYPES:

AD	adit
BH	borehole
FP	flood plain
GS	ground surface/near surface
HA	hand auger boring
LK	lake/pond/open reservoir
OF	outfall/discharge
RV	river/stream
SP	stockpile
TL	tailings pile

QUALIFIERS:

U	Analyte was not detected above the reported detection limit
J	Estimated concentration

DATA SOURCE REFERENCES:

Data source references listed in Attachment 1 are shown in the data summary tables in the "Ref" column.

Data Summary Table
Big Creek - segment BigCrkSeg01

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
BC8184	TL	13	—			$\boxed{85}$	2.7	45	21000	120	640			250
BC8280	TL	13	—			$\boxed{100}$	4.4	27	21000	$\boxed{300}$	700			$\boxed{780}$
Surface Water - Total Metals (ug/l)														
BC8109	RV	13	—				$\boxed{6}$	35 U	12 U		6			3 U
BC8155	RV	13	—			29 U	$\boxed{5}$	35 U	12 U	15 U	6	5 U		3 U
BC8156	RV	13	—			29 U	$\boxed{5}$	35 U	12 U	15 U	5	5 U		4
Surface Water - Dissolved Metals (ug/l)														
BC8109	RV	13	—				2.3 U	$\boxed{12}$	5.7		2.5			2.5 U
BC8155	RV	13	—				2.3 U	$\boxed{14}$	3.7 U		2			2.5 U
BC8156	RV	13	—				$\boxed{2.3}$	$\boxed{12}$	3.7 U		1.8			2.5 U

Data Summary Table
Big Creek - segment BigCrkSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
BC8240	AD	13	---			27	$\boxed{4}$	35 U	12 U	15 U	6	5 U		3 U
BC8241	AD	13	---			29 U	$\boxed{5}$	35 U	120	15 U	13	5 U		17
BC8242	RV	13	---			29 U		35 U	12 U	15 U	7	5 U		4
BC8242	RV	13	---				$\boxed{6}$							
Surface Water - Dissolved Metals (ug/l)														
BC8240	AD	13	---				2.3 U	8 U	3.7 U		2 U			2.5 U
BC8241	AD	13	---				2.3 U	$\boxed{11}$	3.8		2			3.8
BC8242	RV	13	---				$\boxed{6}$	8 U	3.7 U		3			4

Data Summary Table
Big Creek - segment BigCrkSeg03

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
BC8279	TL	13	—			85 U	1.2	17	10000	25	620			24
BC8282	TL	13	—			85 U	1.5	14	17000	30	2700			27
Surface Water - Total Metals (ug/l)														
BC8235	AD	13	—			29 U	5	35 U	12 U	15 U	4	5 U		3 U
BC8236	AD	13	—			29 U	6	35 U	540	15 U	21	5 U		10
BC8237	AD	13	—			29 U	6	35 U	12 U	15 U	5	5 U		3 U
BC8238	RV	13	—			29 U	6	35 U	12 U	15 U	9	5 U		4
BC8239	RV	13	—			29 U	4	35 U	12 U	15 U	5	5 U		3 U
BC8244	AD	13	—			29 U	3 U	35 U	830	15 U	3	5 U		3 U
Surface Water - Dissolved Metals (ug/l)														
BC8235	AD	13	—				2.3 U	8 U	3.7 U		2 U			2.5 U
BC8236	AD	13	—				2.3 U	8 U	11		2 U			2.5 U
BC8237	AD	13	—				2.3 U	8 U	3.7 U		2 U			2.5 U
BC8238	RV	13	—				2.3 U	8.5	3.7 U		2 U			2.5 U
BC8239	RV	13	—				2.3 U	9.4	5.5		2			2.5 U
BC8244	AD	13	—				2.3 U	8 U	8.3		6			2.5 U

Data Summary Table
Big Creek - segment BigCrkSeg04

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X	Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
BC8171	TL	13	—			210	2.1	11	35000	18	120			7
BC8172	TL	13	—			85 U	2.2	26	20000	41	930			120
BC8281	TL	13	—			85 U	1.3	14	8200	23	1000			15
Sediment (mg/kg)														
SF505	HA	2	12/12/1997	0	* 623	22 J	9.11	70.8 J	39900	1900	3060	0.54	8.42 J	1470
Surface Water - Total Metals (ug/l)														
BC260	RV	2	11/05/1997		7.3	1	0.069 U	0.78 U	53.3 J	0.33 U	63.6	0.13 J	0.22 U	12.3 U
BC260	RV	4	05/14/1991				0.2 U			3 U				20 U
BC260	RV	5	10/01/1991				0.2 U			1 U				21
BC260	RV	18	05/25/1999						2600	28	240			70
BC260	RV	3	05/09/1998		5.8	1 U	0.1 U	3 U	29.8	1.7	11.5	0.2 UJ	0.3 U	5 U
BC626	OF	8	04/04/1996		55.9	5 U	5 U	5 U	55.6	1.61	5.1	0.2 U	1 U	5.3
BC626	OF	8	03/26/1998		45 U	40 U	2 U	3 U		25 U	18.5	0.2 U	4 U	20.9
BC8140	SP	13	—			29 U	5	35 U	580	15 U	780	5 U		4
BC8243	AD	13	—			29 U	4	35 U	150	15 U	11	5 U		9
BC8258	AD	13	—			29 U	5	35 U	74	15 U	* 5900	5 U		3 U
BC8259	AD	13	—			29 U	6	35 U	17	15 U	17	5 U		3 U
Surface Water - Dissolved Metals (ug/l)														
BC260	RV	2	11/05/1997		7.13	1.2	0.04 U	0.62	46.7	0.18	61.4	0.2 U	0.03 U	6.93
BC260	RV	4	05/14/1991				0.2 U			3 U				20 U
BC260	RV	5	10/01/1991				0.2 U			1				12 U
BC260	RV	18	05/25/1999				1		14	1	2.8			1.4
BC260	RV	3	05/09/1998		5.9	1 U	0.1 U	3 U	20 U	0.5 U	8.8	0.2 UJ	0.3 U	5 U
BC8140	SP	13	—				2.3 U	12	3.7 U		1.2			2.5 U
BC8243	AD	13	—				2.3 U	13	11		2			2.5 U
BC8258	AD	13	—				2.8	14	56		* 5200			2.5 U
BC8259	AD	13	—				2.3 U	13	6.2		3			2.5 U

ATTACHMENT 3
Statistical Summary Tables for Metals

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment BigCrkSeg01
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Arsenic	2	2	85	100	92.5	0.11	22	2	0	0
Cadmium	2	2	2.7	4.4	3.55	0.34	9.8	0	0	0
Copper	2	2	27	45	36	0.35	100	0	0	0
Iron	2	2	21,000	21,000	21,000	< 0.001	65,000	0	0	0
Lead	2	2	120	300	210	0.6	171	1	0	0
Manganese	2	2	640	700	670	0.06	3,597	0	0	0
Zinc	2	2	250	780	515	0.73	280	1	0	0

Statistical Summary of Total Metals Concentrations in Surface Water
Segment BigCrkSeg01
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	3	3	5	6	5.33	0.11	2	3	0	0
Manganese	3	3	5	6	5.67	0.1	50	0	0	0
Zinc	3	1	4	4	4	< 0.001	30	0	0	0

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment BigCrkSeg01
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	3	1	2.3	2.3	2.3	< 0.001	0.38	1	0	0
Copper	3	3	12	14	12.7	0.09	3.2	3	0	0
Iron	3	1	5.7	5.7	5.7	< 0.001	1,000	0	0	0
Manganese	3	3	1.8	2.5	2.1	0.17	20.4	0	0	0

Statistical Summary of Total Metals Concentrations in Surface Water
Segment BigCrkSeg02
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Arsenic	3	1	27	27	27	< 0.001	50	0	0	0
Cadmium	3	3	4	6	5	0.2	2	3	0	0
Iron	3	1	120	120	120	< 0.001	300	0	0	0
Manganese	3	3	6	13	8.67	0.44	50	0	0	0
Zinc	3	2	4	17	10.5	0.88	30	0	0	0

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment BigCrkSeg02
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	3	1	6	6	6	< 0.001	0.38	1	1	0
Copper	3	1	11	11	11	< 0.001	3.2	1	0	0
Iron	3	1	3.8	3.8	3.8	< 0.001	1,000	0	0	0
Manganese	3	2	2	3	2.5	0.28	20.4	0	0	0
Zinc	3	2	3.8	4	3.9	0.04	42	0	0	0

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment BigCrkSeg03
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	2	2	1.2	1.5	1.35	0.16	9.8	0	0	0
Copper	2	2	14	17	15.5	0.14	100	0	0	0
Iron	2	2	10,000	17,000	13,500	0.37	65,000	0	0	0
Lead	2	2	25	30	27.5	0.13	171	0	0	0
Manganese	2	2	620	2,700	1,660	0.89	3,597	0	0	0
Zinc	2	2	24	27	25.5	0.08	280	0	0	0

Statistical Summary of Total Metals Concentrations in Surface Water
Segment BigCrkSeg03
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Cadmium	6	5	4	6	5.4	0.17	2	5	0	0
Iron	6	2	540	830	685	0.3	300	2	0	0
Manganese	6	6	3	21	7.83	0.86	50	0	0	0
Zinc	6	2	4	10	7	0.61	30	0	0	0

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment BigCrkSeg03
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Copper	6	2	8.5	9.4	8.95	0.07	3.2	2	0	0
Iron	6	3	5.5	11	8.27	0.33	1,000	0	0	0
Manganese	6	2	2	6	4	0.71	20.4	0	0	0

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment BigCrkSeg04
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Arsenic	3	1	210	210	210	< 0.001	22	1	0	0
Cadmium	3	3	1.3	2.2	1.87	0.26	9.8	0	0	0
Copper	3	3	11	26	17	0.47	100	0	0	0
Iron	3	3	8,200	35,000	21,100	0.64	65,000	0	0	0
Lead	3	3	18	41	27.3	0.44	171	0	0	0
Manganese	3	3	120	1,000	683	0.72	3,597	0	0	0
Zinc	3	3	7	120	47.3	1.33	280	0	0	0

Statistical Summary of Total Metals Concentrations in Sediment
Segment BigCrkSeg04
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	1	1	623	623	623	< 0.001	3.3	1	1	1
Arsenic	1	1	22	22	22	< 0.001	13.6	1	0	0
Cadmium	1	1	9.11	9.11	9.11	< 0.001	1.56	1	0	0
Copper	1	1	70.8	70.8	70.8	< 0.001	32.3	1	0	0
Iron	1	1	39,900	39,900	39,900	< 0.001	40,000	0	0	0
Lead	1	1	1,900	1,900	1,900	< 0.001	51.5	1	1	0
Manganese	1	1	3,060	3,060	3,060	< 0.001	1,210	1	0	0
Mercury	1	1	0.54	0.54	0.54	< 0.001	0.179	1	0	0
Silver	1	1	8.42	8.42	8.42	< 0.001	4.5	1	0	0
Zinc	1	1	1,470	1,470	1,470	< 0.001	200	1	0	0

Statistical Summary of Total Metals Concentrations in Surface Water
Segment BigCrkSeg04
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	4	3	5.8	55.9	23	1.24	6	2	0	0
Arsenic	8	1	1	1	1	< 0.001	50	0	0	0
Cadmium	10	4	4	6	5	0.16	2	4	0	0
Iron	8	8	17	2,600	445	2	300	2	0	0
Lead	11	3	1.61	28	10.4	1.46	15	1	0	0
Manganese	9	9	5.1	5,900	783	2.48	50	4	2	1
Mercury	8	1	0.13	0.13	0.13	< 0.001	2	0	0	0
Zinc	11	6	4	70	21.7	1.14	30	1	0	0

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment BigCrkSeg04
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	2	2	5.9	7.13	6.52	0.13	2.92	2	0	0
Arsenic	2	1	1.2	1.2	1.2	< 0.001	150	0	0	0
Cadmium	9	2	1	2.8	1.9	0.67	0.38	2	0	0
Copper	6	5	0.62	14	10.5	0.53	3.2	4	0	0
Iron	7	5	6.2	56	26.8	0.85	1,000	0	0	0
Lead	5	3	0.18	1	0.727	0.65	1.09	0	0	0
Manganese	7	7	1.2	5,200	754	2.6	20.4	2	1	1
Zinc	9	2	1.4	6.93	4.17	0.94	42	0	0	0

ATTACHMENT 4
Screening Levels

SCREENING LEVELS

Based on the results of the human health and ecological risk assessments, 10 chemicals of potential concern (COPCs) were identified for inclusion and evaluation in the RI. The COPCs and appropriate corresponding media (soil, sediment, groundwater, and surface water) are summarized in Table 1. For each of the COPCs listed in Table 1, a screening level was selected.

The screening levels were used in the RI to help identify source areas and media of concern that would be carried forward for evaluation in the feasibility study (FS). The following paragraphs discuss the rationale for the selection of the screening levels.

Applicable risk-based screening levels and background concentrations were compiled from available federal numeric criteria (e.g., National Ambient Water Quality Criteria), regional preliminary remediation goals (PRGs) (e.g., EPA Region IX PRGs), regional background studies for soil, sediment, and surface water, and other guidance documents (e.g., National Oceanographic and Atmospheric Administration freshwater sediment screening values). Selected RI screening levels are listed in Tables 2 through 4.

For the evaluation of site soil, sediment, groundwater, and surface water chemical data, the lowest available risk-based screening level for each media was selected as the screening level. If the lowest risk-based screening level was lower than the available background concentration, the background concentration was selected as the screening level.

Groundwater data are screened against surface water screening levels to evaluate the potential for impacts to surface water from groundwater discharge.

For site groundwater and surface water, total and dissolved metals data are evaluated separately. Risk-based screening levels for protection of human health (consumption of water) are based on total metals results, therefore, total metals data for site groundwater and surface water were evaluated against screening levels selected from human health risk-based screening levels. Risk-based screening levels for protection of aquatic life are based on dissolved metals results, therefore, dissolved metals data for site groundwater and surface water were evaluated against screening levels selected from aquatic life risk-based screening levels.

Table 1
Chemicals of Potential Concern

Chemical	Human Health COPC			Ecological COPC		
	Soil/Sediment	Groundwater	Surface Water	Soil	Sediment	Surface Water
Antimony	X	X				
Arsenic	X	X	X	X	X	
Cadmium	X	X	X	X	X	X
Copper				X	X	X
Iron	X					
Lead	X	X	X	X	X	X
Manganese	X		X			
Mercury			X		X	
Silver					X	
Zinc	X	X	X	X	X	X

Table 2
Selected Screening Levels for Groundwater and Surface Water—Coeur d'Alene River Basin and Coeur d'Alene Lake

Chemical	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Groundwater Total (µg/L)	Groundwater Dissolved (µg/L)
Antimony	6[a]	2.92[b]	6[a]	2.92[b]
Arsenic	50[a]	150[c,d]	50[a]	150[c,d]
Cadmium	2[e]	0.38[b]	2[e]	0.38[b]
Copper	1[e]	3.2[c,d]	1[e]	3.2[c,d]
Iron	300[a]	1,000[c,d]	300[a]	1,000[c,d]
Lead	15[a]	1.09[b]	15[a]	1.09[b]
Manganese	50[a]	20.4[b]	50[a]	20.4[b]
Mercury	2[a]	0.77[c,d]	2[a]	0.77[c,d]
Silver	100[a]	0.43[c,d]	100[a]	0.43[c,d]
Zinc	30[e]	42[c,d]	30[e]	42[c,d]

[a]40 CFR 141 and 143. National Primary and Secondary Drinking Water Regulations. U.S. EPA Office of Water. Office of Groundwater and Drinking Water. http://www.epa.gov/OGWDW/wot/appa.html. October 18, 1999.
[b]Dissolved surface water 95th percentile background concentrations calculated from URS project database.
[c]Freshwater NAWQC for protection of aquatic life are expressed in terms of the dissolved metal in the water column.
[d]Freshwater NAWQC for cadmium, copper, lead, silver, and zinc are expressed as a function of hardness (mg/L of CaCO3) in the water column.
Values above correspond to a hardness value of 30 mg/L.
[e]Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of
Energy. Office of Environmental Management. ES/ER/TM-96/R2. Value based on total metals concentration.

Note:
µg/L - microgram per liter

Table 3
Selected Screening Levels for Surface Water—Spokane River Basin

Chemical	SpokaneRSeg01		SpokaneRSeg02		SpokaneRSeg03	
	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)
Antimony	6[a]	2.92[b]	6[a]	2.92[b]	6[a]	2.92[b]
Arsenic	50[a]	150[c]	50[a]	150[c]	50[a]	150[c]
Cadmium	2[e]	0.38[b]	2[e]	0.38[b]	2[e]	0.38[b]
Copper	1[e]	2.3[c,d]	1[e]	3.8[c,d]	1[e]	5.7[c,d]
Iron	300[a]	1,000[c]	300[a]	1,000[c]	300[a]	1,000[c]
Lead	15[a]	1.09[b]	15[a]	1.09[b]	15[a]	1.4[c,d]
Manganese	50[a]	20.4[b]	50[a]	20.4[b]	50[a]	20.4[b]
Mercury	2[a]	0.77[c]	2[a]	0.77[c]	2[a]	0.77[c]
Silver	100[a]	0.22[c,d]	100[a]	0.62[c,d]	100[a]	1.4[c,d]
Zinc	30[e]	30[c,d]	30[e]	50[c,d]	30[e]	75

[a]40 CFR 141 and 143. National Primary and Secondary Drinking Water Regulations. U.S. EPA Office of Water. Office of Groundwater and Drinking Water. http://www.epa.gov/OGWDW/wot/appa.html. October 18, 1999.
[b]Dissolved surface water 95th percentile background concentrations calculated from URS project database. Technical Memorandum. Estimation of Background Concentration in Soils, Sediments, and Surface Waters. Coeur d'Alene Basin RI/FS. URS. May 2001.
[c]Freshwater NAWQC for protection of aquatic life are expressed in terms of the dissolved metal in the water column.
[d]Freshwater NAWQC for cadmium, copper, lead, silver, and zinc are expressed as a function of hardness (mg/L of $CaCO_3$) in the water column.
[e]Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of Energy. Office of Environmental Management. ES/ER/TM-96/R2. Value based on total metals concentration.

Note:
µg/L - microgram per liter

Table 4
Selected Screening Levels—Soil and Sediment

Chemical	Upper Coeur d'Alene River Basin		Lower Coeur d'Alene River Basin		Spokane River Basin	
	Soil (mg/kg)	Sediment (mg/kg)	Soil (mg/kg)	Sediment (mg/kg)	Soil (mg/kg)	Sediment (mg/kg)
Antimony	31.3[a]	3.30[b]	31.3[a]	3[c]	31.3[a]	3[c]
Arsenic	22[b]	13.6[b]	12.6[b]	12.6[b]	9.34[b]	9.34[b]
Cadmium	9.8[d]	1.56[b]	9.8[d]	0.678[b]	9.8[d]	0.72[b]
Copper	100[d]	32.3[b]	100[d]	28[c]	100[d]	28[c]
Iron	65,000[b]	40,000[c]	27,600[b]	40,000[c]	25,000[b]	40,000[c]
Lead	171[b]	51.5[b]	47.3[b]	47.3[b]	14.9[b]	14.9[b]
Manganese	3,597[b]	1,210[b]	1,760[a]	630[c]	1,760[a]	663[b]
Mercury	23.5[a]	0.179[b]	23.5[a]	0.179[b]	23.5[a]	0.174[c]
Silver	391[a]	4.5[c]	391[a]	4.5[c]	391[a]	4.5[c]
Zinc	280[b]	200[b]	97.1[b]	97.1[b]	66.4[b]	66.4[b]

[a]U.S. EPA Region IX Preliminary Remediation Goals for Residential or Industrial Soil http://www.epa.gov/region09/wasate/sfund/prg. February 3, 2000.
[b]Technical Memorandum. Estimation of Background Concentration in Soils, Sediments, and Surface Waters. Coeur d'Alene Basin RI/FS. URS. May 2001.
[c]Values as presented in National Oceanographic and Atmospheric Administration Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA. M. F. Buchman, 1999. Values generated from numerous reference documents.
[d]Final Ecological Risk Assessment. Coeur d'Alene Basin RI/FS. Prepared by CH2M HILL/URS for EPA Region 10. May 18, 2001. Values are the lowest of the NOAEL-based PRGs for terrestrial biota (Table ES-3).

Note:
mg/kg - milligram per kilogram

CSM Unit 1, Upper Watersheds

Moon Creek

CONTENTS

CONTENTS (Continued)

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FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

AWQC	ambient water quality criteria
BLM	Bureau of Land Management
CDA	Coeur d'Alene
CDR	Coeur d'Alene River
cfs	cubic foot per second
COPC	chemical of potential concern
CSM	conceptual site model
CV	coefficient of variation
East Fork	East Fork of Moon Creek
EPA	U.S. Environmental Protection Agency
EV	expected value
FIS	flood insurance study
FS	feasibility study
IDEQ	Idaho Department of Environmental Quality
MFG	McCulley, Frick & Gilman, Inc.
µg/L	microgram per liter
MoonCrkSeg	Moon Creek segment
msl	mean sea level
PDF	probability density function
PRG	preliminary remediation goal
redox	oxidation reduction
RI	remedial investigation
SL	screening level
South Fork	South Fork Coeur d'Alene River
TMDL	total maximum daily load
URSG	URS Greiner, Inc.
USGS	U.S. Geological Survey
West Fork	West Fork of Moon Creek
WRCC	Western Regional Climate Center

1.0 INTRODUCTION

The Moon Creek Watershed is located within the Coeur d'Alene River basin and is a south to southwest-flowing tributary of the South Fork Coeur d'Alene River (South Fork). The Bureau of Land Management (BLM) has identified 14 source areas (e.g., mining waste rock dumps, adits, and jig tailings piles) within the watershed (BLM 1999). Though the West Fork of Moon Creek is relatively unaffected by mining activities, the main stem of Moon Creek has been heavily affected.

During the 1998, 1999 and 2000 field seasons, the USDA Forest Service implemented the East Fork Moon Creek Reclamation Project as a CERCLA non-time critical removal project to address the Charles Dickens and Silver Crescent mine and mill sites. The project entailed removing 130,000 cubic yards of jig and flotation tailings, waste rock, and contaminated soil with placement in an unlined combined waste repository onsite. The repository base includes a limestone drain system with impervious berm to address groundwater. The cover is an engineered multi-layer capillary-break type cap containing a geosynthetic clay liner. This project also included closing and sealing four adits and two mine shafts. While the drainage from the Silver Crescent adit had sample results that indicated neutral pH and low metals, a wetlands buffer was installed to intercept this drainage. In addition, the project included over 3300 feet of channel rehabilitation, floodplain re-construction and nearly 10 acres of revegetation by seeding and planting methods (REI 2000 and Johnson 2000).

This watershed is one of eight watersheds assigned to conceptual site model (CSM) Unit 1, Upper Watersheds (see Part 1, Section 2, Conceptual Site Model Summary). The watershed itself has been divided into two segments to focus this investigation (Figure 1.1-1). Brief descriptions of each segment are presented in this section.

1.1 SEGMENT DESCRIPTIONS

Segment MoonCrkSeg01 contains the headwaters of the West Fork of Moon Creek (West Fork) down to its confluence with Moon Creek (Figure 4.1-1). The BLM identified two source areas in this segment. This segment has been relatively unaffected by mining activities.

Segment MoonCrkSeg02 contains the headwaters of Moon Creek and continues down the main stem of Moon Creek to its confluence with the South Fork (Figure 4.1-2). The BLM identified 12 source areas in this segment. Mining and release of tailings from the Silver Crescent Mine and Mill and the Charles Dickens Mine have caused the deposition of mining waste on the narrow floodplain of the lower part of Moon Creek. Remediation work has been implemented at the above sites. Sampling of surface water indicates that metals concentrations in surface water are greater than ambient water quality criteria (AWQC).

1.2 REPORT ORGANIZATION

The remedial investigation report is divided into seven parts. This report on the Moon Creek Watershed is one of eight reports contained within Part 2 presenting the RI results for the eight CSM Unit 1 upper watersheds. The content and organization of this report are based on the U.S. Environmental Protection Agency's (EPA's) Guidance Document for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final (USEPA 1988). This report contains the following sections:

- Section 2–Physical Setting, includes discussions on the watershed's geology, hydrogeology, and surface water hydrology.
- Section 3–Sediment Transport Processes
- Section 4–Nature and Extent of Contamination, includes a summary of chemical results and estimates of mass loading from source areas
- Section 5–Fate and Transport, includes chemical and physical transport processes for metals
- Section 6–References

Risk evaluations and potential remedial actions associated with source and depositional areas are described in the human health risk assessment, the ecological risk assessment, and the feasibility study (all under separate cover).

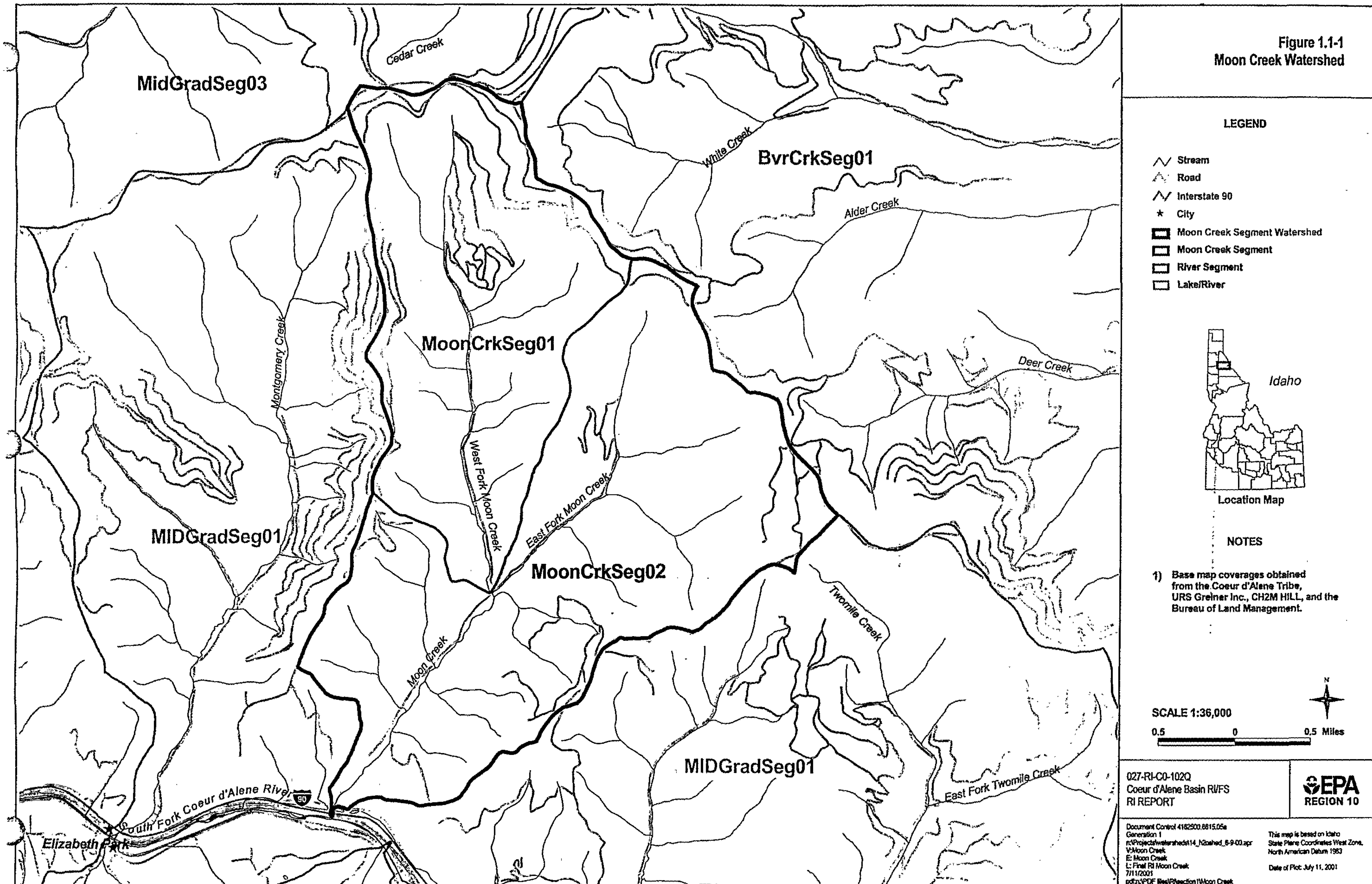


Figure 1.1-1
Moon Creek Watershed

2.0 PHYSICAL SETTING

2.1 GEOLOGY AND MINES

The geology and mining history of the Moon Creek Watershed are presented in this section.

2.1.1 Geomorphic Setting

The Moon Creek Watershed is located on the north side of the South Fork Coeur d'Alene River (South Fork), about 3 miles east of Kellogg and 7 miles west of Wallace (Part 1, Figures 1.2-1 and 1.2-2). Moon Creek, West Fork Moon Creek, and East Fork Moon Creek are the principal drainages of the watershed. The elevation change in the watershed is approximately 2,000 feet, with elevations ranging from about 4,500 feet above mean sea level (msl) at the headwaters of West Fork Moon Creek and East Fork Moon Creek, to 2,500 feet msl at the confluence of Moon Creek and the South Fork. Like most drainages in the district, East Fork, West Fork, and Moon Creek all flow through narrow, steep-walled, V-shaped canyons throughout their course.

2.1.2 Bedrock Geology

Weakly metamorphosed sedimentary rocks assigned to the Precambrian Belt Supergroup are the most prevalent rocks within the Moon Creek Watershed. Most of the watershed lies within Prichard Formation argillite with the exception of the headwaters of West Fork Moon Creek and East Fork Moon Creek, which drain the Burke Formation quartzite (Umpleby and Jones 1923).

Waste rock piles are present at all mine workings and consist of broken, angular rock that is generally not milled and is typically dumped near the mouth of workings. The chemical content of waste rock in the Moon Creek Watershed is discussed in Section 4, Nature and Extent of Contamination.

2.1.3 Structural Geology

Northwest-trending faults dominate the structural fabric of the Moon Creek Watershed (Hobbs et al. 1965). The trace of the Moon Creek Fault crosses the confluence of Moon Creek and the South Fork (Part 1, Figure 3.2-1), and other unnamed, northwest-trending faults are present within the watershed but not shown on figures in this document (Hobbs et al. 1965).

Parallel to the trend of the northwest-trending faults is a prominent anticlinal fold, designated the Moon Creek Anticline (Hobbs et al. 1965). The fold axis of the Moon Creek Anticline (not shown on any figure in this document) is about 1 mile southwest of the Moon Creek Fault (Hobbs et al. 1965).

2.1.4 Soils

Like most of the soils throughout the district, the soils of the Moon Creek Watershed can be grouped into two broad categories: hillside soils and valley soils. Hillside soils typically consist of silty loam with variable amounts of gravels and clay, generally less than 2-feet thick (MFG 1992; Camp Dresser & McKee 1986). Valley soils are primarily found within and along the flanks of the lower reaches of Moon Creek, and along the 0.5-mile reach of West Fork Moon Creek above its confluence with Moon Creek (Part 1, Figure 3.2-1). The valley soils are mapped as Quaternary alluvium.

In the Moon Creek Watershed, Quaternary alluvial deposits are a mixture of cobbly gravels, sands, and silts. West of the 2-mile-long reach of Moon Creek above the confluence with the South Fork are relatively small deposits of Quaternary terrace gravels, which are characterized by well-developed sandy soil overlying cobbly to bouldery gravels (Part 1, Figure 3.2-1, map symbol QTog) (Box et al. 1999).

2.1.5 Ore Deposits

Eight mines reportedly operated in the Moon Creek Watershed; however, the only recorded production was from the Charles Dickens Mine and the Silver Crescent Mine on East Fork Moon Creek (Stratus 1999).

The deposits at the Charles Dickens and Silver Crescent Mines consist of what is referred to as fault-controlled fissure vein deposits, which are steeply dipping veins hosted primarily by the Prichard Formation (USFS 1995). The principal ore minerals are galena (lead and silver) and sphalerite (zinc) (USFS 1995). The main non-ore (gangue) minerals are quartz, pyrite, and pyrrhotite (USFS 1995). Aside from pyrite associated with the ore deposits, the Prichard Formation commonly contains disseminated pyrite as irregular grains and crystals aligned parallel to the bedding (USFS 1995).

2.1.6 Mining History

A brief summary of available information on historical mining activities is presented in this section. During the RI/FS process, an extensive list of mines, mills, and other source areas was developed based on a list originally developed by the Bureau of Land Management (BLM 1999). This list is presented in Section 4.1, Nature and Extent, and in Appendix I.

Mining in the Moon Creek watershed began around 1902, when the Charles Dickens Mine first reported documented ore production. Records indicate at least eight mines and two prospects having been located in the watershed (Ridolfi 1998). Production records for the Evolution Mining District, in which the Moon Creek Watershed is located, indicate that most of the recorded ore production for the Moon Creek Watershed can be attributed to the Charles Dickens Mine. The Charles Dickens, which later consolidated with the Silver Crescent Mine, produced a recorded 4,604 tons of ore between 1902 and 1930. From this ore, an estimated 367 tons of lead, 39 tons of zinc, 16 tons of copper, 0.5 tons of silver and 31 ounces of gold were recovered (Mitchell and Bennett 1983). It has also been estimated that approximately 3,803 tons of tailings were produced during the processing of the Charles Dickens' ores at the Charles Dickens/Silver Crescent Mill (SAIC 1993). None of the other mines located in the watershed have documented production histories.

Some of the other mines that operated in the Moon Creek Watershed include the Cogdill Mine, Highland Mine, Main Standard Mine, Royal Anne Mine, and Washington-Idaho Mine. An unnamed tunnel and several unnamed adits have also been identified within the watershed (CH2M HILL 1998). Additional details of the mining and milling history of the Charles Dickens and Silver Crescent mines are included in the following sections.

2.1.6.1 Mines

The mines that operated in the Moon Creek Watershed for which ore production was recorded are listed in Table 2.1-1. This table includes the production years of the mine, estimated volumes of ore and tailings produced as a result of the mining activity and the segment in which the mine is (or was) located. Only mines with documented ore production are listed. Additionally, some mining operations were carried out at more than one location, occasionally in more than one segment or even more than one watershed. The ore production listed in Table 2.1-1 is the total production for all of the mining operations.

2.1.6.2 Mills

Table 2.1-2 lists the mills with operations in the Moon Creek drainage for which there are records. This table includes the operating years of the mill and a summary of ownership as well as the segment in which the mill is located. Not all mills are listed, as records were not available for all mills.

2.1.7 Mining Workings

Underground workings in many mines are very extensive and act as collection and distribution systems for groundwater. Individual mine workings in this watershed are typically located within a single, relatively steep ridge. Recharging water infiltrates at the highest levels of a mountain ridge and discharges on the same ridge. This is referred to as a local flow system, characterized by short groundwater flow paths (a flow path is the route by which the water enters and exits the groundwater system) (Toth 1963).

Adits and tunnels in this watershed act as discharge points for groundwater. Typically adit drainage discharges directly to surface water or first infiltrates waste rock piles before discharging to surface water from seeps. Six adits and three shafts (not shown in figures) have been identified in the Moon Creek Watershed (IGS 1997). Three adits within the watershed are known to discharge mine drainage (USFS 1995). The discharge of metals from mine workings is discussed further in Section 4, Nature and Extent of Contamination, and in Section 5, Fate and Transport.

2.2 HYDROGEOLOGY

2.2.1 Conceptual Hydrogeologic Model

The Moon Creek Watershed occupies approximately 10 square miles, and West Fork Moon Creek, East Fork Moon Creek, and Moon Creek are the principal drainages of the watershed (Figure 1.1-1). West Fork Moon Creek flows approximately 3 miles to the confluence with Moon Creek to the south. East Fork Moon Creek flows approximately 2 miles to the confluence with Moon Creek to the south. From the confluence, Moon Creek flows in a southerly direction to its confluence with the South Fork. The elevation change in the watershed is approximately 2,000 feet, with elevations ranging from 4,500 feet above msl at the headwaters of West Fork Moon Creek and East Fork Moon Creek, to 2,500 feet above msl at the confluence with the South Fork.

The hydrogeology of the Moon Creek Watershed can be divided into two main groundwater systems: the bedrock aquifer and the shallow alluvial aquifer. The conceptual hydrogeologic model for the watershed assumes that a single unconfined aquifer is present in the shallow alluvial sediments, and these sediments are the principal hydrostratigraphic unit in the watershed. The shallow alluvial sediments consist of natural materials as well as mine tailings and waste rock.

Although relatively little hydrogeologic data is available for the watershed as a whole, a study of the Silver Crescent Mine and Mill complex located on East Fork Moon Creek confirmed the presence of an unconfined alluvial aquifer that is about 30 feet thick in the vicinity of the mine (USFS 1995). In general, the alluvium increases in thickness from the headwaters of East Fork and West Fork Moon Creek toward the confluence with the South Fork.

The bedrock aquifer within the Moon Creek Watershed consists of argillites and quartzites of the Precambrian formations of the Belt Supergroup, including (principally) the Prichard Formation, and a relatively minor amount of Burke Formation (as reported in Umpleby and Jones 1923) at the headwaters of East Fork Moon Creek and West Fork Moon Creek (Part 1, Figure 3.2-1).

In general, the bedrock has very low permeability. Secondary features such as fractures, faults, or mine workings may increase the permeability substantially. The hydrogeology of the bedrock aquifer is discussed in Section 2.1.7, Mine Workings.

The groundwater system of unconsolidated sediments overlying less permeable rocks occurs in an elongate, V-shaped trough along the entire length of East Fork Moon Creek, West Fork Moon Creek, and Moon Creek.

As observed in wells in the Canyon Creek and Ninemile Creek Watersheds, it is assumed that groundwater levels fluctuate seasonally. Monitoring of groundwater levels along East Fork Moon Creek in the vicinity of the Silver Crescent Mine and Mill site confirmed seasonal variation (Paulsen and Girard 1996). Groundwater levels are generally highest in the late spring and lowest during winter and early spring when precipitation rates are lowest and snowmelt is not occurring.

2.2.2 Aquifer Parameters

Aquifer parameters are not available from the Moon Creek Watershed for the presumed single unconfined aquifer in unconsolidated sediments overlying bedrock. However, based on reported lithologic similarities between the presumed single unconfined aquifer in the Moon Creek

Watershed and the upper aquifer of the Smelterville Flats-Bunker Hill groundwater system, it is reasonable to expect that aquifer parameters presented in Table 2.2-1 are similar to the presumed single unconfined aquifer of the Moon Creek Watershed. This assumption was confirmed by the presence of gravels, cobbles, and sand (as is present in the Smelterville Flats - Bunker Hill area) in thirteen borings completed at the Silver Crescent Mine and Millsite along East Fork Moon Creek (Paulsen and Girard 1996). The range of horizontal hydraulic conductivities presented in Table 2.2-1 are typical of clean sand and gravels (Freeze and Cherry 1979).

2.2.3 Flow Rates and Directions

Based on similar watersheds (e.g., Canyon Creek and Ninemile Creek), it can be assumed that the general groundwater flow direction in the Moon Creek Watershed parallels the flow of Moon Creek surface water. Based on water level data recorded in Canyon Creek, it can be assumed that there are localized areas in Moon Creek where the flow direction is downstream and toward the creek and other areas where the flow direction is downstream and away from the creek.

2.2.4 Surface Water/Groundwater Interaction

Based on groundwater information collected from the Canyon Creek Watershed, it can be assumed that shallow alluvial deposits along Moon Creek serve as aquifers, and if they are hydraulically connected, they are capable of taking from or adding to flow in the creek. It is further assumed that the interaction of the surface water in Moon Creek and groundwater in the shallow alluvial aquifers creates gaining or losing reaches. During the spring snowmelt and resulting high creek levels, the gaining reaches of the stream may temporarily experience reversals in the surface water/groundwater hydraulic gradient (i.e., become losing reaches).

2.2.5 Water Quality and Water Chemistry

Water quality parameters (temperature, pH, specific conductance, salinity, turbidity, and oxidation-reduction [redox] potential) and water chemistry data (e.g., chloride, sulfates, and sulfides) are discussed further in Section 4, Nature and Extent of Contamination and in Section 5, Fate and Transport.

2.2.6 Groundwater Use

Use of groundwater supplies for domestic, municipal, and industrial applications (as it relates to human consumption) is discussed in the baseline human health risk assessment.

2.3 SURFACE WATER HYDROLOGY

The following sections describe the surface water hydrology of Moon Creek, also known as Moon Gulch, a tributary to the South Fork Coeur d'Alene River. The watershed has a drainage area of approximately 9 square miles and approximately 3.8 miles of mapped channel.

2.3.1 Available Information

The available hydrologic information for Moon Creek includes U.S. Geological Survey (USGS) stream flow estimates for water year 1999, climatological data for Kellogg, ID, and instantaneous discharge data from a variety of consultants obtain between 1991 and 1999.

The USGS developed a synthetic hydrograph based on crest stage gage readings and correlation to nearby continuous streamflow record stations for Moon Gulch, Station number 12413190 (USGS 2000). This station is located at the downstream end of MoonCrkSeg02. One year of discharge estimates, water year 1999, is available for Moon Creek. Water year 1999 ran from October 1, 1998 to September 30, 1999. Precipitation data from the Western Regional Climate Center (WRCC) station at Kellogg were collected for the same period (WRCC 2000). This precipitation gage is the nearest gage to Moon Creek. The mean daily discharge hydrograph and precipitation data are presented in Figure 2.3.1-1.

Stream discharge measurements were taken in association with water quality sampling events completed by McCulley, Frick & Gilman, Inc. (MFG), URS, Idaho Department of Environmental Quality (IDEQ), and USGS. These measurements have occurred since 1991. These data are summarized in Table 2.3.1-1.

2.3.2 Hydrologic Description

This section describes the hydrology of Moon Creek. Base flow discharge is estimated at 1 to 2 cubic feet per second (cfs), and average annual discharge is approximately 9 cfs. The maximum mean daily discharge estimated during water year 1999 was 56 cfs, on May 25, 1999.

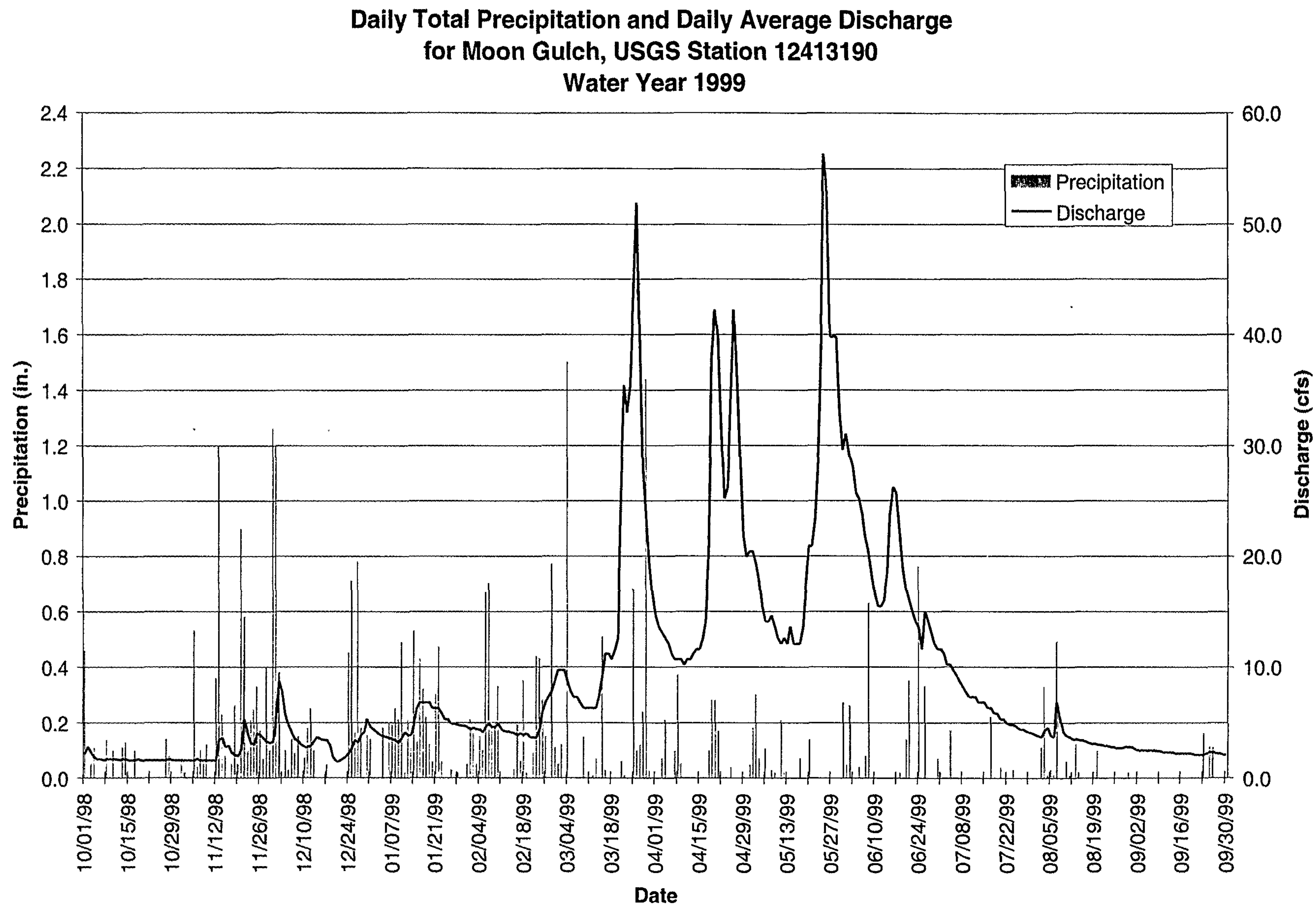
Total annual average precipitation at the WRCC Kellogg Station for the 95-year period of record is 30.8 inches, while for water year 1999 the total precipitation was 37.8 inches (WRCC 2000). Total annual average snowfall for the WRCC station is 54.3 inches, while for water year 1999 the total snowfall was 35.5. While these comparisons do not address monthly variations in precipitation, they do indicate that the water budget for water year 1999 was somewhat typical with above average total precipitation and below average snowfall.

Table 2.3.2-1 summarizes the mean monthly flows Moon Creek, mean monthly precipitation (rain and snow water content), and total snowfall at the WRCC station at Kellogg for water year 1999. Table 2.3.2-1 and Figure 2.3.1-1 indicate the majority of precipitation occurred from October to March (78 percent at the Kellogg gage). Much of this precipitation was in the form of snow and did not run off into the channel immediately. As indicated in Figure 2.3.1-1 and Table 2.3.2-1, stream discharges remained relatively low (less than the annual mean discharge of 9 cfs) through February 1999. In contrast, from March 15 to July 6, stream discharges exceeded the annual mean discharge.

The increase in discharge during the spring and summer is attributed to increased runoff caused by snowmelt. Maximum daily temperature and mean daily discharge for water year 1999 for the Moon Creek are presented in Figure 2.3.2-1. Increased temperatures over these periods melted much of the snow in the upper basin. Rain on snow also may have contributed to these increased discharges as indicated in Figure 2.3.2-1 where precipitation events also occurred during periods of increased temperature.

The discharge range indicated in Table 2.3.1-1 is in the range of values indicated by the water year 1999 hydrograph, with two measurements in excess of the maximum mean daily discharge for water year 1999. On May 28, 1998, IDEQ measured discharges in Moon Creek of 136.9 cfs and on March 8, 1999, IDEQ measured a discharge of 112.5 cfs. These measurements show that discharges in excess of the estimated discharge for water year 1999 should be expected.

Based on the existing data, it is expected that water year 1999 was typical from a total snowfall and total water budget perspective in the Moon Creek Watershed. Runoff from spring snowmelt dominates the surface water hydrology. Variations in snowfall, temperature, and rainfall from year to year will influence the magnitude and timing of peak discharges.



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Moon Creek Series 07/11/01	Figure 2.3.1-1

Daily Maximum Temperature and Daily Average Discharge
for Moon Gulch, USGS Station 12413190
Water Year 1999

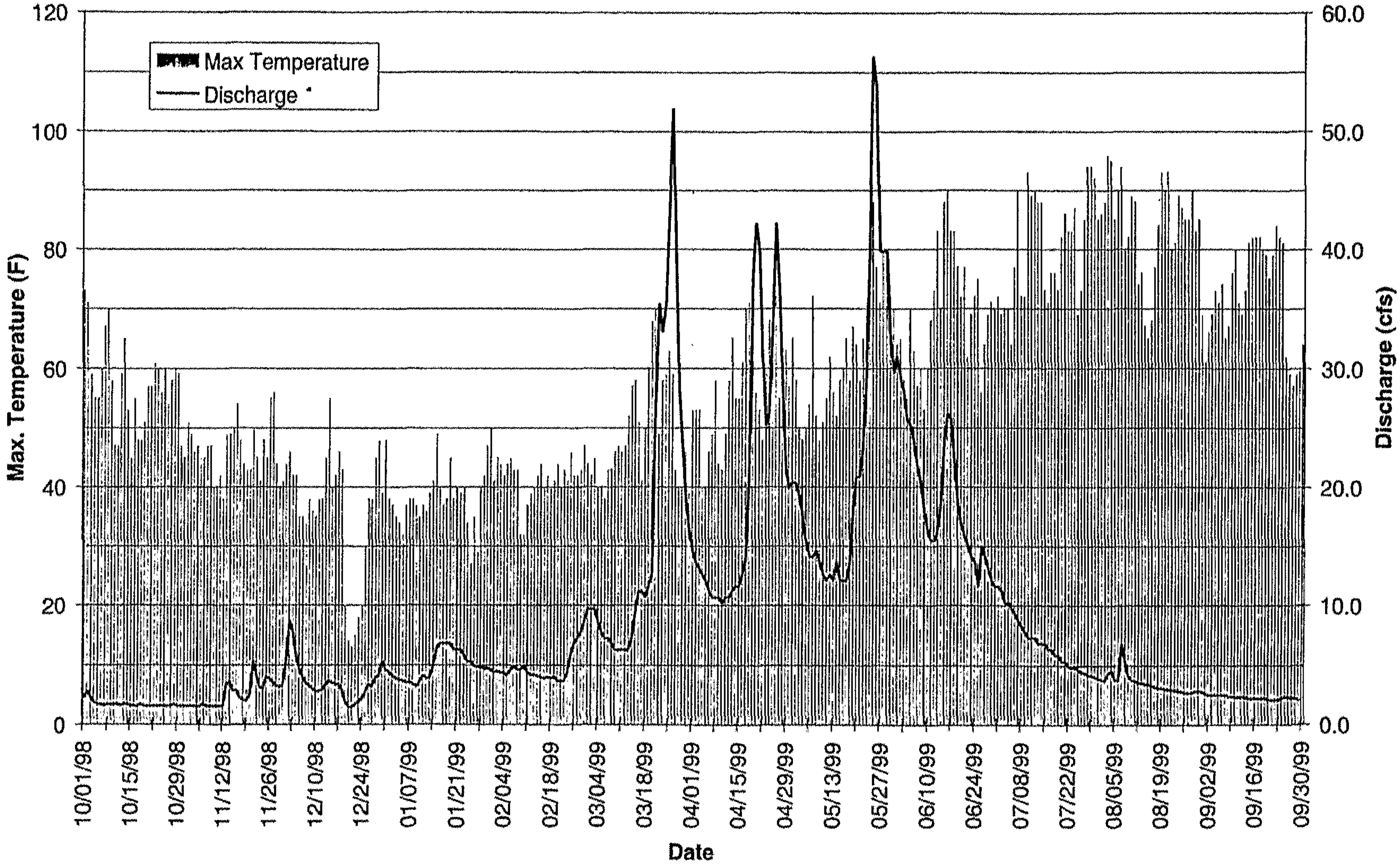


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Figure 2.3.2-1

Table 2.1-1
Mines in the Moon Creek Watershed With Recorded Production

Segment	Production Years	Ore (tons)	Mill	Tailings (tons)	Comments
Charles Dickens/Silver Crescent Mine					
MoonCrk01	1902-1930	4,604	Charles Dickens	3,803	The Charles Dickens Mine is located at the end of the main road in Moon Gulch. The mine was in operation by 1907, and in 1908 was the largest shipper of ore in the Evolution district. Records by the Idaho State Inspector of Mines report ore production of 4,604 tons from 1902 through 1930. Some development work was conducted during 1930, but the mine was idle for much of 1930 through 1937. The mine was again active in 1937-1938, 1948-1950, and possibly 1963-1964. There is little other historical mention of the site until the *68th Annual Report of the Mining Industry in Idaho for 1969-1970* listed the site as idle. The mill and other on-site structures were dismantled in 1996 and 1997 (Ridolfi 1998). The Silver Crescent Mine was incorporated in 1911. Records by the Idaho State Inspector of Mines report development activity at the mine between 1911 and 1926, however there is no record of production during this time. The mine remained idle after 1926 until the mine's merger with the Charles Dickens in 1937 (Ridolfi, 1998).

Source: Stratus 1999, unless otherwise noted.

Table 2.1-2
Mills With Documented Operations in Moon Creek Watershed

Segment	Operating Years	Ownership	Comments
Charles Dickens			
MoonCrk01	1907-1908 1908-1928 1928-1948	Charles Dickens, Silver Crescent	The Charles Dickens built a 100-ton concentrator on the property in 1907. The mill was destroyed the next year and was replaced with a 150-ton mill. The property was sold shortly thereafter and was operated only intermittently until about 1925. In 1928, the 150-ton jig concentrator was replaced with a 150-ton flotation mill. The mill operated through 1928 but for only a short period in 1929 before the mill was damaged by fire. There is no record of the mill operating after this time until 1940. The mill was operated intermittently through the 1940s, processing ore from the Silver Dollar Mining Company at Terror Gulch and reprocessing tailings from various sources. There is little other historical mention of the site until the *68th Annual Report of the Mining Industry in Idaho for 1969-1970* listed the site as idle. The mill and other on-site structures were dismantled in 1996 and 1997 (Ridolfi 1998).

Source: Ridolfi 1998

Table 2.2-1
Summary of Aquifer Parameters of the Smelterville Flats-Bunker Hill Upper Aquifer

Hydro-stratigraphic Unit	Horizontal Hydraulic Conductivity (ft/day)	Vertical Hydraulic Conductivity (ft/day)	Transmissivity 2 (ft/day)	Storativity (unitless)	Effective Porosity
Upper Aquifer	500 - 10,790	0.0025[a]	10,002-216,852	0.0015-0.09	23.6-29.0

[a]Based on one test conducted on a sample of upper aquifer alluvium from borehole GR-26U (see Part 1, Figure 3.2-1) at 13.5 feet below ground surface. No units given in original source document.
Source: MFG (1992)

Table 2.3.1-1
Summary of Discharge Data From Project Database
Segment MoonCrkSeg02

Segment Name	Site Location	Measured By	No. of Readings	Beginning Date	Ending Date	Minimum Discharge	Maximum Discharge	Units
MoonCrkSeg02	MC 262	IDEQ, MFG, URS, USGS	68	05/14/91	08/31/99	0.38	136.95	cfs

cfs - cubic feet per second

Table 2.3.2-1
Precipitation Summary and Discharge Comparison for Water Year 1999
Kellogg, Idaho
NOAA Cooperative Station 104831

Climate Indicators	Monthly Totals												Annual
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Total Precipitaiton (in.)	1.4	7.5	5.3	4.6	5.7	5.1	1.7	1.5	2.7	0.5	1.3	0.4	37.8
Total Snowfall (in.)	0.0	0.8	11.0	5.2	13.1	5.1	0.3	0.0	0.0	0.0	0.0	0.0	35.5
Mean Monthly Discharge (cfs) (Moon Gulch)	1.7	2.6	3.6	4.9	4.8	17.0	20.2	22.8	19.2	6.7	3.5	2.3	9.1
Average Precipitation for Period of Record (in.)	2.7	3.8	3.9	3.7	2.8	2.9	2.4	2.5	2.2	1.0	1.1	1.7	30.8
Average Snowfall for Period of Record (in.)	0.3	5.0	14.1	18.5	10.1	5.6	0.7	0.0	0.0	0.0	0.0	0.0	54.3

cfs - cubic feet per second

3.0 SEDIMENT TRANSPORT PROCESSES

Sediment derived in Moon Creek is transported into the South Fork approximately 3 miles upstream of Kellogg, Idaho. Based on review of aerial photographs, sediment sources in Moon Creek are mining waste, mobilization of channel bed sediment, bank erosion, and some rock debris situated adjacent to channels. In this discussion, the available information, analyses, and likely sediment sources are described.

3.1 AVAILABLE INFORMATION

Sediment transport gaging data are not available for Moon Creek; therefore, estimates of sediment yield are not provided in this report.

For Moon Creek, 1998 photographs by URS Greiner, Inc. (URSG) and CH2M HILL (URSG and CH2M HILL 1999) were reviewed. Channel descriptions and potential sediment sources are described below.

3.2 ANALYSES

3.2.1 Channel Descriptions

The 1998 set of aerial photographs by URSG and CH2M HILL were reviewed to describe Moon Creek. This review and interpretation focused on morphologic features indicating stream instability, channel migration, channel aggregation or degradation and other features that may contribute sediment to the system.

3.2.1.1 MoonCrkSeg01

The West Fork of Moon Creek is contained within MoonCrkSeg01. It has a drainage area of approximately 3.6 square miles. Based on the aerial photographs reviewed, no major sources of sediment are contained in MoonCrkSeg01. The channel is contained in a narrow valley by well vegetated hillslopes. Likely sediment sources in MoonCrkSeg01 are channel bed remobilization and minor bank erosion.

3.2.1.2 MoonCrkSeg02

MoonCrkSeg02 has a drainage area of approximately 5.4 square miles. From the mouth to the confluence with the West Fork, the channel is situated in a valley floor 100 to 200 feet wide. The channel appears to be confined to the current location by road embankments and culverts. The channel banks are moderately well vegetated for much of this reach. Many high gradient ephemeral channels enter in this section of channel. About 3,000 feet downstream of the West Fork confluence, the valley decreases in width. Approximately 2,000 feet downstream of the confluence with the West Fork, a small road cut is apparent in the photographs reviewed. This may constitute a sediment source, provided a surface water connection exists.

Upstream of the West Fork Confluence, the channel is confined in general location by steep valley walls and road embankments. Approximately 4,000 feet upstream of the West Fork confluence and continuing 2,000 to 3,000 feet upstream, Moon Creek flows adjacent to rock piles and tailings ponds of both the Charles Dickens Mine and Silver Crescent Mill site. If a surface water connection exists between the channel and exposed rock or soil, this area may contribute sediment to the system.

Likely sediment sources in MoonCrkSeg02 are channel bed remobilization and minor bank erosion. The rock debris piles in and around both the Charles Dickens Mine and Silver Crescent Mill site also may contribute to the sediment load.

3.3 SUMMARY

The Moon Creek Watershed appears to have few sediment sources. Likely sediment sources throughout the basin include channel bed remobilization, and minor bank erosion. Some sediment may be contributed at the rock and debris piles adjacent to the channel in MoonCrkSeg02; however, these appear less significant than other areas in the Coeur d'Alene Basin.

These observations were based on a limited review of the available data, photographs, and topographic maps at the time of review. Not all potential sediment sources were identified as potential sediment sources literally cover the entire watershed. Primary sources were identified based on review of the available information.

4.0 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination and mass loading in the two segments of the Moon Creek watershed are discussed in this section. Section 4.1 describes chemical concentrations found in environmental media, including horizontal and vertical extent. For each watershed segment, the discussion includes remedial investigation data chemical analysis results; comparison of chemical results to selected screening levels (Part 1, Section 5.1); and focused analysis of identified source areas. In Section 4.2, preliminary estimates of mass loading are presented.

4.1 NATURE AND EXTENT

The nature and extent of the ten metals of potential concern identified in Part 1, Section 5.1 (antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, silver, and zinc) in surface soil, subsurface soil, sediment, groundwater, and surface water are discussed in this section. Locations with metals detected in any matrix at concentrations 1 times (1x), 10 times (10x), and 100 times (100x), the screening level were identified and presented in the following data summary tables. The magnitudes of exceedence (10x and 100x) were arbitrarily selected to delineate areas of contamination. Metals identified in this evaluation are further evaluated in either the human health or ecological risk assessments (under separate cover).

Historical and recent investigations at areas within the study area are listed and summarized in Part 1, Section 4. Data source references are included as Attachment 1. Chemical data collected in Moon Creek and used in this evaluation are presented at the end of this report. Data summary tables include sampling location, data source reference, collection date, depth, and reported concentration. Screening level exceedences are highlighted. Sampling locations are shown on Figures 4.1-1 through 4.1-3. All chemical data collected and compiled for this study are included in Attachment 2.

The nature and extent of contamination were evaluated by screening chemical results against applicable risk-based screening criteria and available background concentrations. Screening levels are used in this analysis to identify source areas and media (e.g., soil, sediment, groundwater, and surface water) of concern that will be evaluated in the feasibility study (FS).

Statistical summaries for each metal in surface soil, subsurface soil, sediment, groundwater, and surface water are included as Attachment 3 and discussed in the subsections below. The summaries include the number of samples analyzed; the number of detections; the minimum and maximum detected concentrations; the average and coefficient of variation; and the screening level (SL) to which the detected concentration is compared. Proposed screening levels were compiled from available federal numeric criteria (e.g., National Ambient Water Quality Criteria), regional preliminary remediation goals (PRGs) (e.g., EPA Region IX PRGs), regional baseline or background studies for soil, sediment, and surface water, and other guidance documents (e.g., National Oceanographic and Atmospheric Administration freshwater sediment screening values). The screening level selection process is discussed in detail in Part 1, Section 5.1.

Source areas within Moon Creek are presented in Tables 4.1-1and 4.1-2. These sites are based source areas initially identified by the BLM (1999) and further refined by CH2MHILL and URS during the RI/FS process. The tables include source area names, source ID, source area acres, description, number of samples by matrix type, and metals exceeding 1x, 10x, and 100x the screening levels in surface soil, subsurface soil, sediment, groundwater, and surface water. Surface water results are discussed in Mass Loading (Section 4.2). This table reflects source area descriptive measurements initially generated in the CSM and subsequently refined by the FS.

It should be noted that the number of samples identified for each source area was determined using the project Geographical Information System. Only sampling locations located within a source area polygon (shown on Figures 4.1-1 through 4.1-3) are included in Tables 4.1-1 and 4.1-2; therefore, there may be samples collected from source areas and listed in the data summary tables in Attachment 2 that are not accounted for in Tables 4.1-1 and 4.1-2.

The following sections present segment-specific sampling efforts and results according to matrix type. Given the extensive geographic range of the Coeur d'Alene Basin, sampling efforts were focused on areas of potential concern; therefore, more samples were collected from known mining-impacted areas near the creek, than from other areas within the watershed.

4.1.1 Segment MoonCrkSeg01

4.1.1.1 Surface Soil

One surface soil sample was collected and analyzed for total metals in segment MoonCrkSeg01. Arsenic was detected at a concentration greater than 10x the screening level.

4.1.1.2 Identified Source Areas

Summary source area data are presented in Table 4.1-1. Two source areas occur in this segment. Two surface soil samples were collected from an unnamed tunnel. Arsenic was detected at a concentration greater than 10x the screening level.

4.1.2 Segment MoonCrkSeg02

4.1.2.1 Surface Soil

Three surface soil samples were collected from a depth of 0 to 0.5 feet and analyzed for total metals. Arsenic, cadmium, copper, lead, and zinc were detected at concentrations greater than 10x the screening levels.

4.1.2.2 Surface Water

Ninety-three surface water samples were collected and analyzed in segment MoonCrkSeg02 for total and dissolved metals. Zinc was detected at a concentration exceeding 10x the screening level in two total metals samples. Dissolved lead was detected at a concentration greater than 10x the screening level in one sample.

4.1.2.3 Identified Source Areas

Chemical data for surface soil, subsurface soil, sediment, groundwater, and surface water were reviewed together to identify source areas within segment MoonCrkSeg02 that may be significant contributors of metals to Moon Creek. Summary source area data are presented in Table 4.1-2.

Three of the 12 source areas in this segment were sampled for surface soil and a fourth source area was sampled for surface water. Surface soil concentrations greater than 10x the screening levels were detected for arsenic, cadmium, copper, lead, and zinc. Surface water concentrations exceeded 10x the screening levels for dissolved lead and total zinc.

4.2 SURFACE WATER MASS LOADING

In Part 1 of this report (Setting and Methodology, Section 5.3.1), the concept of mass loading and its use in the remedial investigation was presented. Section 4.2 of the Canyon Creek Nature and Extent further discussed the use of plotting discrete sampling events versus the probabilistic analysis of the mass loading data in Fate and Transport.

The Moon Creek Watershed has very limited data by which to assess mass loading in surface water or groundwater. As summarized in Table 4.2-1, there is one data point for which total lead and dissolved zinc mass loading can be calculated. This sampling location is in Moon Creek, close to the confluence with the South Fork.

A review of the lead loading data in Table 4.2-1 indicates that the total lead mass load ranges from less than 1 pound per day to 17 pounds per day (April 16, 1997). As shown in the table, lead load increases with flow.

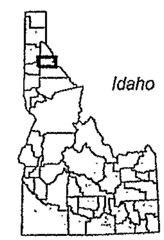
A review of the zinc loading in Table 4.2-1 indicates that the dissolved zinc mass load ranges from less than 1 pound per day to 179 pounds per day (February 21, 1997). As shown in the table, zinc load increases with flow.

Based on the data in Table 4.2-1, relative to other tributaries, the discharge from Moon Creek does not add substantial total lead and dissolved zinc load to the South Fork. There are floodplain deposits in segment MoonCrkSeg02 that could act as a pathway for metal migration in groundwater. Current information is not sufficient to evaluate the contributions of metals from groundwater to surface water loading.

Figure 4.1-1
Moon Creek Segment MoonCrkSeg01 Source Areas and Soil/Sediment Sampling Locations

LEGEND

- ▲ Tailings Sampling Location
- Stream
- Road
- ★ City
- Moon Creek Segment 1
- Source Area and Name



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

SCALE 1:24,000

0 — 0.5 Miles

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Generation 1
n:\projects\ri_fs\moon_creek\moon_creek.apr
V: MoonCrkSeg01 Soil
E:soil
L: Final RI MoonCrkSeg01 soil
7/11/2001

This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 11, 2001

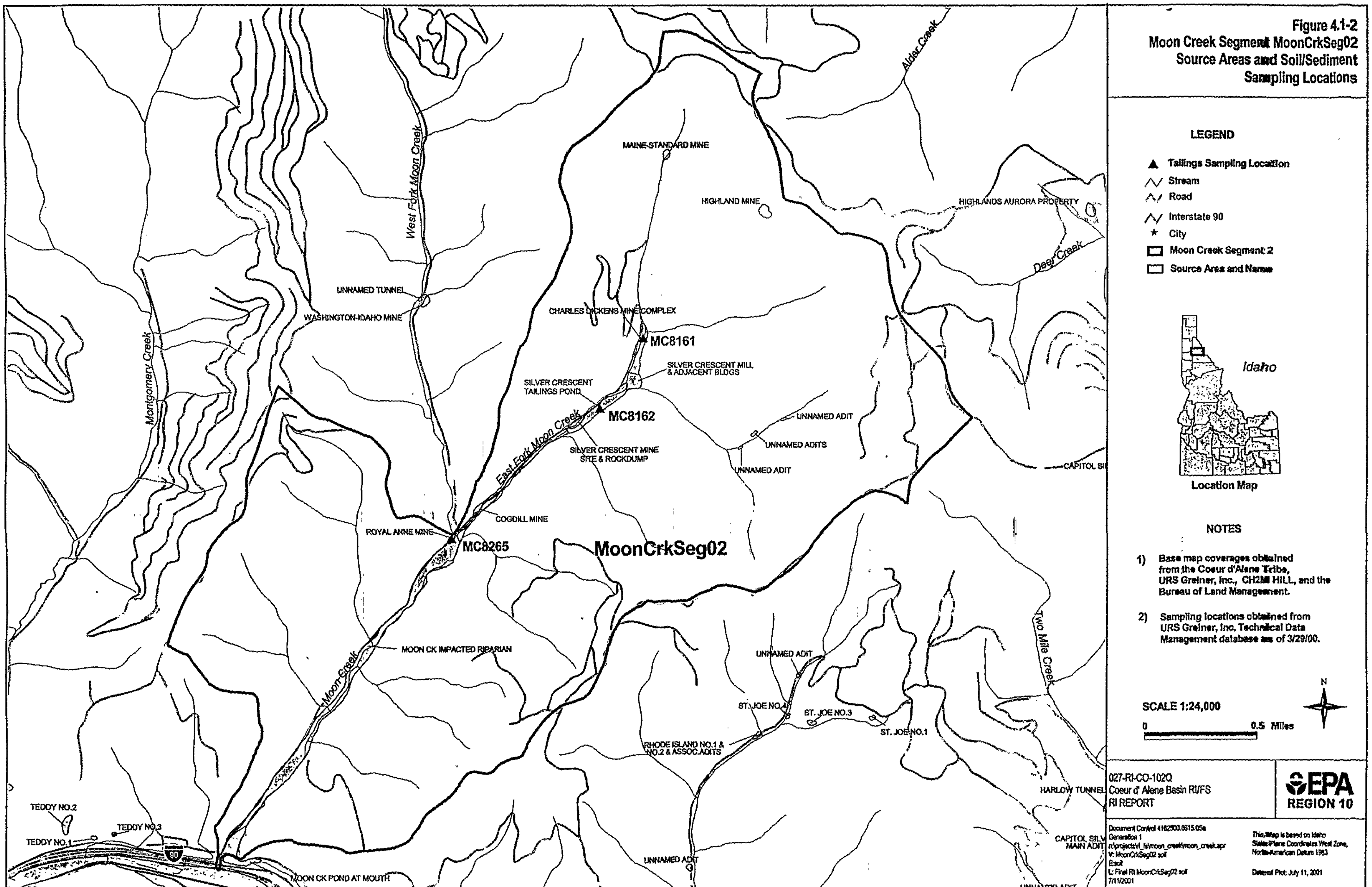
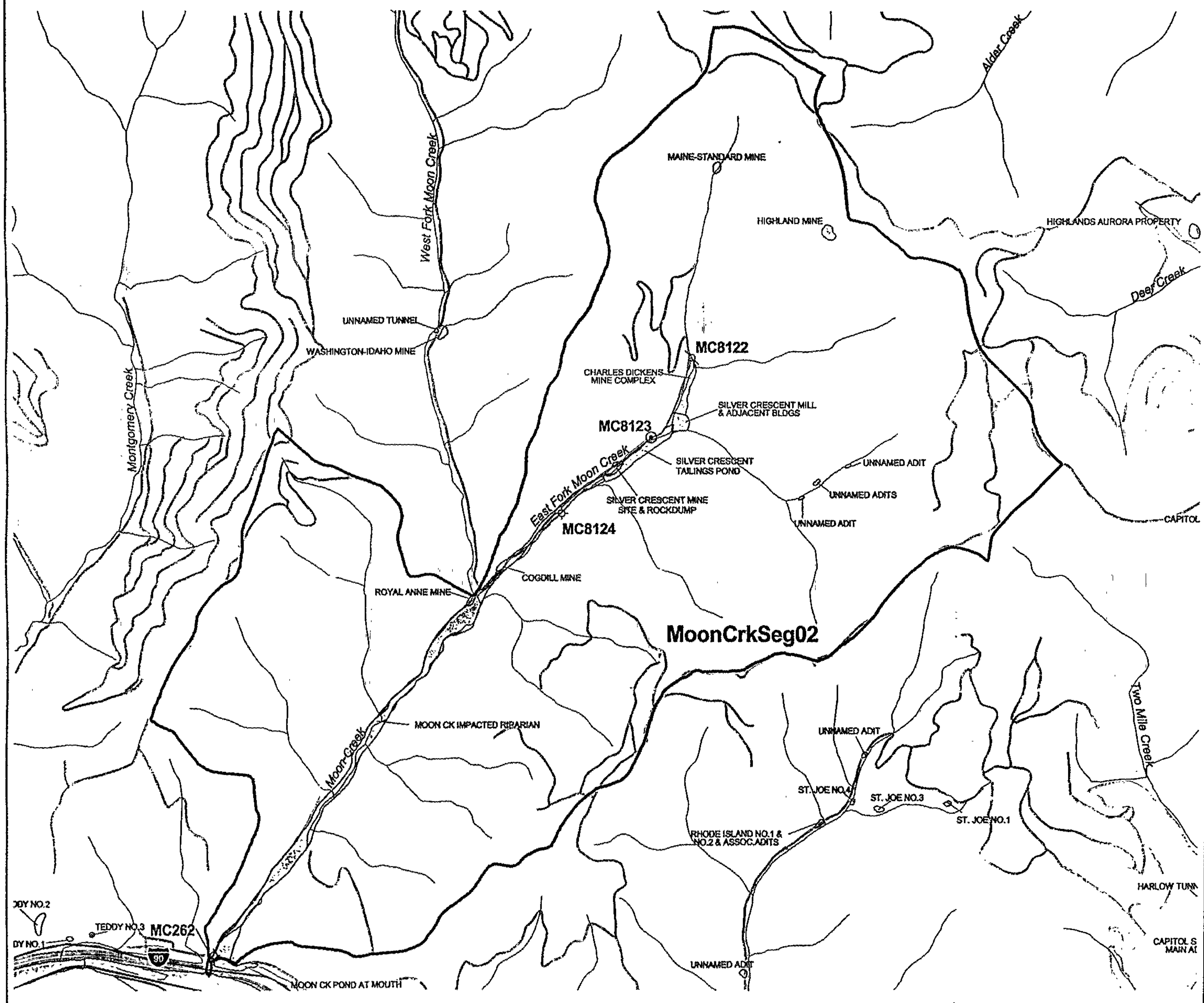


Figure 4.1-2
Moon Creek Segment MoonCrkSeg02
Source Areas and Soil/Sediment
Sampling Locations

Figure 4.1-3
Moon Creek Segment MoonCrkSeg02 Source Areas and Surface Water Sampling Locations



LEGEND

- Adit Sampling Location
- River Sampling Location
- Seep Sampling Location
- Stream
- Road
- City
- Moon Creek Segment 2
- Source Area and Name

Idaho

Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner, Inc., CH2M HILL, and the Bureau of Land Management.

2) Sampling locations obtained from URS Greiner, Inc. Technical Data Management database as of 3/29/00.

N

SCALE 1:24,000

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027-RI-CO-102Q
Coeur d' Alene Basin RI/FS
RI REPORT

EPA
REGION 10

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V: MoonCrkSeg02 SW
E: surface water
L: Final RI MoonCrkSeg02 SW
7/11/2001

This Map is based on Idaho State Plane Coordinates West Zone, North American Datum 1983

Date of Plot: July 11, 2001

Table 4.1-1
Potential Source Areas Within Moon Creek - segment MoonCrkSeg01

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type		Metals > 1X	Metals > 10X	Metals > 100X
UNNAMED TUNNEL	KLE061	0.13	Floodplain waste rock	SL	1	SST: Cd-1, Pb-1, Zn-1	SST: As-1	
WASHINGTON-IDAHO MINE	KLE007	0.62	Upland waste rock					

Matrix Types

DR: Debris/Rubble	SD: Sediment
GW: Groundwater	SL: Soil
RK: Rock/Cobbles/Gravel	SS: Surface Soil
SB: Subsurface Soil	SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals	SST: Surface Soil
GWT: Groundwater - Total Metals	SWD: Surface Water - Dissolved Metals
SBT: Subsurface Soil	SWT: Surface Water - Total Metals
SDT: Sediment	

Analytes

Ag: Silver	Hg: Mercury
As: Arsenic	Mn: Manganese
Cd: Cadmium	Pb: Lead
Cu: Copper	Sb: Antimony
Fe: Iron	Zn: Zinc

Table 4.1-2
Potential Source Areas Within Moon Creek - segment MoonCrkSeg02

Source Area Name	Source ID	Area (Acres)	Source Description	No. Samples By Matrix Type		Metals > 1X	Metals > 10X	Metals > 100X
CHARLES DICKENS MINE COMPLEX	KLE078	4.93	Upland waste rock	SL	1	SST: Fe-1	SST: As-1, Cd-1, Cu-1, Pb-1, Zn-1	
COGDILL MINE	KLE013	0.53	Upland waste rock					
HIGHLAND MINE	KLE009	1.38	Upland waste rock					
MAINE-STANDARD MINE	KLE008	0.65	Upland waste rock (erosion potential)					
MOON CK IMPACTED RIPARIAN	KLE041	49.62	Floodplain sediments	SW	91	SWD: Cd-79, Pb-33, Zn-89 SWT: Cd-1, Cu-1, Pb-2, Zn-89	SWD: Pb-1 SWT: Zn-1	
ROYAL ANNE MINE	KLE014	0.49	Upland waste rock (erosion potential)	SL	1	SST: Cu-1, Fe-1, Pb-1	SST: As-1	
SILVER CRESCENT MILL & ADJACENT BLDGS	KLE077	2.98	Upland tailings					
SILVER CRESCENT MINE SITE & ROCKDUMP	KLE076	1.18	Adit drainage Upland waste rock					
SILVER CRESCENT TAILINGS PONDS	KLE012	6.39	Floodplain tailings	SL	1	SST: Cu-1, Zn-1	SST: As-1, Pb-1	
UNNAMED ADIT	KLE063	0.15	Upland waste rock (erosion potential)					
UNNAMED ADIT	KLE064	0.13	Upland waste rock (erosion potential)					
UNNAMED ADITS	KLE065	0.23	Upland waste rock (erosion potential)					

Matrix Types

DR: Debris/Rubble
GW: Groundwater
RK: Rock/Cobbles/Gravel
SB: Subsurface Soil
SD: Sediment
SL: Soil
SS: Surface Soil
SW: Surface Water

Matrix Groupings

GWD: Groundwater - Dissolved Metals
GWT: Groundwater - Total Metals
SBT: Subsurface Soil
SDT: Sediment
SST: Surface Soil
SWD: Surface Water - Dissolved Metals
SWT: Surface Water - Total Metals

Analytes

Ag: Silver
As: Arsenic
Cd: Cadmium
Cu: Copper
Fe: Iron
Hg: Mercury
Mn: Manganese
Pb: Lead
Sb: Antimony
Zn: Zinc

Table 4.2-1
Mass Loading Moon Creek

Location	Segment	Sample Type	Sample No.	Sample Date	Flow (CFS)	Total Lead Conc. (µg/L)	Total Lead Load (lbs/day)	Dissolved Zinc Conc. (µg/L)	Dissolved Zinc Load (lbs/day)
MC262	2	RV	172069	14-May-91	14.9	4	0.3	102	8.2
MC262	2	RV	172104	01-Oct-91	0.9	5	0.0	84	0.4
MC262	2	RV	173575	29-Oct-93	2.5	2.5 U	-	160	2.1
MC262	2	RV	173576	01-Dec-93	2.7	2.5 U	-	160	2.3
MC262	2	RV	173577	21-Dec-93	2.2	7	0.1	187	2.2
MC262	2	RV	173577	21-Dec-93	3.1	7	0.1	187	3.1
MC262	2	RV	173578	21-Jan-94	7.1	2.5 U	-	160	6.1
MC262	2	RV	173578	21-Jan-94	7.1	2.5 U	-	160	6.1
MC262	2	RV	173579	17-Feb-94	3.8	2.5 U	-	156	3.2
MC262	2	RV	173580	07-Mar-94	23.2	2.5 U	-	114	14.3
MC262	2	RV	173581	23-Mar-94	15.3	2.5 U	-	119	9.8
MC262	2	RV	173581	23-Mar-94	16.0	2.5 U	-	119	10.3
MC262	2	RV	173582	06-Apr-94	14.0	2.5 U	-	101	7.6
MC262	2	RV	173583	18-Apr-94	10.6	2.5 U	-	97	5.6
MC262	2	RV	173584	03-May-94	6.2	2.5 U	-	104	3.5
MC262	2	RV	173585	20-May-94	4.3	2.5 U	-	127	3.0
MC262	2	RV	173586	07-Jun-94	4.3	2.5 U	-	141	3.3
MC262	2	RV	173587	24-Jun-94	2.8	2.5 U	-	121	1.8
MC262	2	RV	173588	22-Jul-94	2.0	2.5 U	-	104	1.1
MC262	2	RV	173589	17-Aug-94	0.4	2.5 U	-	74	0.2
MC262	2	RV	173589	17-Aug-94	1.4	2.5 U	-	74	0.6
MC262	2	RV	173591	05-Oct-94	1.8	2.5 U	-	78	0.7
MC262	2	RV	173592	16-Nov-94	3.8	2.5 U	-	152	3.1
MC262	2	RV	173593	14-Dec-94	3.5	2.5 U	-	159	3.0
MC262	2	RV	173594	10-Jan-95	8.5	2.5 U	-	160	7.3
MC262	2	RV	173595	09-Feb-95	62.8	2.5 U	-	114	38.6
MC262	2	RV	173596	08-Mar-95	112.5	2.5 U	-	120	72.7
MC262	2	RV	173597	22-Mar-95	79.9	7	3.0	113	48.7
MC262	2	RV	173598	12-Apr-95	16.0	6	0.5	117	10.1
MC262	2	RV	173599	25-Apr-95	14.6	7	0.6	114	9.0
MC262	2	RV	173600	09-May-95	6.8	7	0.3	128	4.7
MC262	2	RV	173601	23-May-95	4.2	2.5 U	-	125	2.8
MC262	2	RV	173602	12-Jun-95	4.2	5 J	-	134	3.0
MC262	2	RV	173603	27-Jun-95	2.9	7	0.1	96	1.5
MC262	2	RV	173604	11-Jul-95	2.8	2.5 U	-	139	2.1
MC262	2	RV	173605	25-Jul-95	2.1	6	0.1	106	1.2
MC262	2	RV	173606	14-Aug-95	1.8	5 J	-	226	2.2
MC262	2	RV	173607	13-Sep-95	1.8	7	0.1	110	1.0
MC262	2	RV	173608	18-Oct-95	8.9	5 J	-	174	8.3
MC262	2	RV	173609	21-Nov-95	8.9	6	0.3	164	7.8
MC262	2	RV	173612	28-Feb-96	130.0	6	4.2	125	87.6
MC262	2	RV	173613	27-Mar-96	62.8	2.5 U	-	198	67.0
MC262	2	RV	173614	17-Apr-96	97.1	10	5.2	154	80.6
MC262	2	RV	173615	08-May-96	69.1	8	3.0	125	46.6
MC262	2	RV	173616	19-Jun-96	18.4	5 J	-	144	14.3

Table 4.2-1 (continued)
Mass Loading Moon Creek

Location	Segment	Sample Type	Sample No.	Sample Date	Flow (CFS)	Total Lead Conc. (µg/L)	Total Lead Load (lbs/day)	Dissolved Zinc Conc. (µg/L)	Dissolved Zinc Load (lbs/day)
MC262	2	RV	173618	21-Aug-96	7.4	15	0.6	86	3.4
MC262	2	RV	173619	26-Sep-96	5.0	2.5 U	-	110	2.9
MC262	2	RV	186012	29-Oct-96	11.1	5	0.3	115	6.9
MC262	2	RV	186023	26-Nov-96	11.1	7	0.4	146	8.7
MC262	2	RV	186039	13-Dec-96	30.8	2.5	0.4	152	25.2
MC262	2	RV	186056	29-Jan-97	18.4	2.5	0.2	129	12.8
MC262	2	RV	186073	21-Feb-97	276.0	6	8.9	120	178.5
MC262	2	RV	186093	26-Mar-97	18.4	0.06	0.0	106	10.5
MC262	2	RV	186113	16-Apr-97	124.0	26	17.3	105	70.2
MC262	2	RV	186153	23-Jun-97	6.8	8	0.3	166	6.1
MC262	2	RV	186173	23-Jul-97	24.3	7	0.9	156	20.4
MC262	2	RV	186193	14-Aug-97	10.2	2.5	0.1	111	6.1
MC262	2	RV	186213	03-Sep-97	9.7	2.5	0.1	92	4.8
MC262	2	RV	186233	16-Oct-97	2.6	2.5	0.0	120	1.7
MC262	2	RV	168465	05-Nov-97	2.4	0.47 J	-	130	1.7
MC262	2	RV	186253	24-Nov-97	4.3	2.5	0.1	132	3.1
MC262	2	RV	186272	17-Dec-97	3.2	2.5	0.0	154	2.7
MC262	2	RV	186291	21-Jan-98	4.3	4	0.1	142	3.3
MC262	2	RV	186310	25-Feb-98	14.6	2.5	0.2	110	8.7
MC262	2	RV	186329	20-Mar-98	30.8	2.5	0.4	111	18.4
MC262	2	RV	186348	23-Apr-98	14.6	2.5	0.2	151	11.9
MC262	2	RV	46324	05-May-98	6.9	2.6	0.1	318	11.8
MC262	2	RV	202240	28-May-98	136.9	12	8.8	99	73.1
MC262	2	RV	202254	25-Jun-98	7.1	5 U	-	138	5.3
MC262	2	RV	202275	27-Jul-98	3.2	5 U	-	87	1.5
MC262	2	RV	202295	25-Aug-98	2.6	6	0.1	84	1.2
MC262	2	RV	202365	24-Sep-98	2.5	5 U	-	100	1.3
MC262	2	RV	186945	28-Oct-98	1.3	2	0.0	127	0.9
MC262	2	RV	186946	18-Nov-98	1.6	2	0.0	123	1.1
MC262	2	RV	186947	14-Dec-98	4.8	2	0.1	167	4.3
MC262	2	RV	186948	21-Jan-99	21.0	3	0.3	0.101	0.0
MC262	2	RV	186949	22-Mar-99	63.0	47	15.9	57	19.4
MC262	2	RV	186950	20-Apr-99	43.0	5	1.2	45	10.4
MC262	2	RV	186951	04-May-99	17.0	1	0.1	56	5.1
MC262	2	RV	186952	23-May-99	8.7		-	61	2.9
MC262	2	RV	186953	16-Jun-99	4.2	1	0.0	74	1.7
MC262	2	RV	202173	20-Jul-99	2.1	0.49	0.0	93	1.1
MC262	2	RV	202174	04-Aug-99	1.5	0.34	0.0	81	0.7
MC262	2	RV	202175	31-Aug-99	1.4	0.6	0.0	85	0.6

Notes:
- : No data or delta not calculated

RV: River Sample
CFS: Cubic feet per Second

µg/L: Micrograms per liter
lbs/day: pounds per day
U: not detected
J: estimated concentration

5.0 FATE AND TRANSPORT

The fate and transport of metals in surface water, groundwater, and sediment in the Moon Creek Watershed are discussed in this section. A conceptual model of fate and transport, important fate and transport mechanisms, and a summary of the probabilistic model developed to evaluate fate and transport, were presented in the fate and transport section in the Canyon Creek report and are not repeated here. This section draws upon that general information.

Initial findings on metals concentrations and mass loading for each segment, as presented above in Section 4, Nature and Extent, are briefly summarized in Section 5.1. Results of the probabilistic modeling are presented in Section 5.2. Sediment transport is summarized in Section 5.3. A summary of fate and transport of metals in Moon Creek is presented in Section 5.4.

5.1 INTRODUCTION

The lowest and highest dissolved cadmium and zinc and total lead loadings measured during six sampling events (May, 1991; October, 1991; November, 1997; May, 1998; November, 1998; and May, 1999) are listed in Table 5.1-1. Potential sources of these metals in the watershed were identified for each segment in Section 4.1 and preliminary mass loading estimates were discussed in Section 4.2. Brief summaries of those results are included in this section.

Segment MoonCrkSeg01 contains the headwaters of the West Fork of Moon Creek down to its confluence with Moon Creek. The BLM identified two source areas in this segment. This segment has been relatively unaffected by mining activities. No surface water data are available for this segment.

Segment MoonCrkSeg02 contains the headwaters of Moon Creek and continues down the main stem of Moon Creek to its confluence with the South Fork. The BLM identified 12 source areas in this segment. Mining and release of tailings from the Crescent Mine and the Charles Dickens Mine on the East Fork have caused the deposition of mining waste on the narrow floodplain of the lower part of Moon Creek. Remediation work has been implemented at the above sites. Sampling of surface water indicates that metals concentrations in surface water are greater than screening levels. Preliminary calculations of mass loading indicated minimal loading of cadmium and lead. The maximum calculated zinc load was 178.5 pounds per day (CH2M HILL 1998).

5.2 MODEL RESULTS

Results from the probabilistic model are discussed for cadmium, lead, and zinc in this section. Modeling results for estimates of discharge are discussed in Section 5.2.1. Modeling results for estimates of chemical concentrations and mass loading of cadmium, lead, and zinc are discussed in Section 5.2.2. Modeling results are summarized in Table 5.2-1. All modeling results are included in Appendix C.

Sufficient data (≥10 samples) were available for one sampling location, MC262. Only sampling locations with 10 or more individual data points for each parameter of interest were evaluated. Sampling location MC262 is shown on Figure 4.1-3. This sampling location is located immediately upstream of the confluence of Moon Creek with the South Fork.

5.2.1 Estimated Discharge

A lognormal plot of discharge data at sampling location MC262 at the mouth of Moon Creek is shown in Figure 5.2-1. In Figure 5.2-1, the discharge in cubic feet per second is plotted on a log scale versus the normal standard variate. The normal standard variate is equivalent to the standard deviation for a normalized variable. When the log of a variable (e.g., discharge) is plotted versus the standard normal variate, a straight line will result if the data are lognormally distributed. The cumulative distribution function gives the probability that the observed discharge at any given time will not be exceeded by the estimated discharge at that cumulative probability. The cumulative distribution function is plotted versus the normal standard variate in Figure 5.2-2. To determine the probability of occurrence of a specific discharge, first select the discharge of interest on Figure 5.2-1, then find its corresponding normal standard variate. Using that value for the normal standard variate, look up its corresponding cumulative probability in Figure 5.2-2. For example, for a discharge of 10 cfs, the normal standard variate is approximately 0.3 (Figure 5.2-1). Looking on Figure 5.2-2, this value corresponds to a cumulative probability of approximately 0.62; therefore, approximately 62 percent of the time, discharges at this location will be 10 cfs or less.

The probability distribution function (PDF) shown in Figure 5.2-1 is a predictive tool that can be used to estimate the expected discharge and provide a quantitative estimate of the probability that the observed discharge will not exceed a given value. Conversely, one can find the estimated discharge rate having a specified probability of exceedance or non-exceedance by the observed discharge.

As shown in Figure 5.2-1, there is a good fit of the lognormal regression line (solid line in Figure 5.2-1) to the data. This goodness of fit, as evidenced by a high coefficient of determination ($r^2 = 0.95$), supports the assumption that discharges are lognormally distributed. The dotted line represents a lognormal distribution generated using the coefficient of variation (CV, standard deviation divided by the average) and expected value of the actual data.

The discharge rate having a specific probability of exceedence or non-exceedence by an actual discharge may also be estimated by using the relationships shown in Figure 5.2-1. The estimated expected value of the discharge at the mouth of Moon Creek is approximately 13.2 cfs. Approximately one-quarter of the discharge data points lie above the expected discharge.

5.2.2 Estimated Zinc, Lead, and Cadmium Concentrations and Mass Loading

Dissolved cadmium and zinc, and total lead concentrations and loads were evaluated using the probabilistic model at the sampling location (MC262) that contained a minimum of ten data points.

The lognormal distribution of dissolved zinc, total lead, and dissolved cadmium concentrations and dissolved zinc and cadmium and total lead loading at sampling location MC262 are shown in Figures 5.2-3 through 5.2-8. The data follow a lognormal distribution as shown by the high r-squared values (r^2). For dissolved concentrations, the r-squared values for zinc and cadmium were 0.97 and 0.93, respectively. The corresponding value for the lognormal regression plot of total lead concentrations was 0.94. The corresponding values for dissolved zinc and cadmium and total lead loads were 0.93, 0.99, and 0.91, respectively, when loads were plotted lognormally. All the r-squared values were significant at $\alpha < 0.0001$.

To assist in interpreting and placing the results in context, screening levels and expected values are shown on the figures when appropriate. The screening level for dissolved cadmium in surface waters is 0.38 μg/L. Approximately 20 percent of the cadmium concentrations at MC262 are greater than this screening level. No dissolved cadmium concentrations exceeded 10 times the screening level (Figure 5.2-3). The estimated expected dissolved cadmium concentration (0.68 μg/L) is greater than the screening level.

All measured total lead concentrations except one fall below the screening level (15 μg/L). The estimated expected lead concentration (approximately 3.7 μg/L) is also less than the screening level (Figure 5.2-4).

All dissolved zinc concentrations (Figure 5.2-5) measured at sampling location MC262 exceed the screening level of 42 μg/L. All measured data for dissolved zinc fall between the screening level and 10 times the screening level. The estimated expected dissolved zinc concentration (121 μg/L) exceeds by approximately 3-fold the dissolved zinc screening level.

No total maximum daily loads (TMDLs) were established for mass loading at the mouth of Moon Creek (USEPA 2000). Accordingly, no TMDLs were available to compare actual loadings with established criteria. The estimated dissolved zinc load at the mouth of Moon Creek is approximately 9.9 pounds/day. The estimated expected value for total lead loading is approximately 0.42 pounds/day. Approximately 20 percent of the data points exceed the estimated value of lead loading. The estimated expected value for dissolved cadmium loading is 0.0466 pounds/day. Approximately 25 percent of the data exceed the estimated expected value.

5.2.2.1 Segment MoonCrkSeg01

Segment MoonCrkSeg01 encompasses the West Fork Moon Creek watershed. This segment has few potential sources of mining waste and is relatively unaffected. The Washington-Idaho mine is found in this segment.

5.2.2.2 Segment MoonCrkSeg02

Segment MoonCrkSeg02 includes the headwaters and the main stem of Moon Creek. Potential sources in this segment include the Silver Crescent mine and mill complex and the Charles Dickens mine complex. Mining and release of tailings from mill sites adjacent to Moon Creek have resulted in deposition of mining wastes on the narrow floodplain of the lower part of Moon Creek. Concentrations of dissolved zinc in Moon Creek in this segment exceed screening levels by two to three times. Remedial actions at the Silver Crescent mine and mill complex have recently been completed by the U.S. Forest Service. At this time, the effects of these actions on metal loadings and concentrations at the mouth of Moon Creek are unknown.

Data from one sampling location in this segment, MC262, situated at the mouth of Moon Creek, was analyzed probabilistically.

The estimated expected value for dissolved cadmium is 0.68 μg/L, which is greater than the screening level of 0.38 μg/L. The estimated expected value of the dissolved cadmium load is 0.0466 pounds/day.

The estimated value of the total lead concentration is 3.7 µg/L, which is less than the screening level of 15 µg/L. The estimated total lead load is 0.42 pounds/day.

The estimated expected value of the dissolved zinc concentration at this location is approximately 121 µg/L, which exceeds the screening level (42 µg/L) by more than three times. The estimated expected value of the dissolved zinc load is approximately 9.9 pounds/day.

5.2.2.3 Concentrations Versus Discharge

The following discussion is based on evaluation of data at the mouth of Moon Creek (MC262). There was a negative correlation between a regression plot of the log of the dissolved zinc concentrations versus discharges (concentrations decreased as discharges increased) which is significant at $\alpha = < 0.10$ (α is the probability the correlation is due to chance). As one would expect, given that the majority of the zinc is in the dissolved phase, there was also a decrease in total zinc concentrations with increased discharge rates which was significant at $\alpha = < 0.32$. Total lead concentrations increased with increasing discharge ($\alpha < 0.001$). Estimated values of dissolved ($\alpha < 0.10$) cadmium concentrations increased with increased discharge at the mouth of Moon Creek.

5.3 SEDIMENT FATE AND TRANSPORT

Sediment fate and transport processes were presented in Section 3. Results of the sediment transport evaluation presented in Section 3 are summarized in this section.

Sediment derived in Moon Creek is transported into the South Fork approximately 3 miles upstream of Kellogg, Idaho. Sediment transport gaging data are not available for Moon Creek; therefore, estimates of sediment yield are not provided in this report. Based on review of aerial photographs, sediment sources in Moon Creek are mining wastes, mobilization of channel bed sediment, bank erosion, and some rock debris situated adjacent to channels.

Segment MoonCrkSeg01, containing the West Fork of Moon Creek, has a drainage area of approximately 3.6 square miles. Based on the aerial photographs reviewed no major sources of sediment are contained in segment MoonCrkSeg01. The channel is contained in a narrow valley by well vegetated hillslopes. Likely sediment sources in MoonCrkSeg01 are channel bed remobilization and minor bank erosion. Sediment samples were not collected from this segment; however, one surface soil sample was collected from the Washington-Idaho Mine that is located adjacent to the West Fork. If we assume sediment concentrations may be represented by metals concentrations reported for soil, soil and sediment concentrations exceed screening levels for arsenic, cadmium, copper, lead, and zinc.

Segment MoonCrkSeg02, containing the headwaters and main stem of Moon Creek, has a drainage area of approximately 5.4 square miles. From the mouth to the confluence with the West Fork, the channel is situated in a valley floor 100 to 200 feet wide. Much of the width of the valley is occupied by residential dwellings. The channel appears to be confined to the current location by road embankments and culverts. The channel banks are moderately well vegetated for much of this reach. Many high gradient ephemeral channels enter in this section of channel.

Upstream of the West Fork Confluence, the channel is confined in general location by steep valley walls and road embankments. Approximately 4,000 feet upstream of the West Fork confluence and continuing 2,000 to 3,000 feet upstream, Moon Creek flows adjacent to rock piles and tailings ponds of both the Charles Dickens Mine and Silver Crescent Mill site. Likely sediment sources in segment MoonCrkSeg02 are channel bed remobilization and minor bank erosion. The rock debris piles in and around both the Charles Dickens Mine and Silver Crescent Mill site also may contribute to the sediment load.

Sediment samples were not collected from this segment; however, three surface soil samples were collected from mining-related sites located adjacent to Moon Creek. If we assume sediment concentrations may be represented by metals concentrations reported for soil, soil and sediment concentrations exceed screening levels for arsenic, cadmium, copper, lead, and zinc.

Sediment sources include channel bed remobilization, minor bank erosion, lateral migration and rock debris piles adjacent to the stream. Though suspended and bedload sediment samples were not collected and analyzed for metals, suspended and bedload sediment concentrations may be represented by metals concentrations reported for soil and sediment samples collected in the Moon Creek Watershed. As presented in Section 4.1, Nature and Extent, metals concentrations in soil samples exceeded screening levels, especially for arsenic, cadmium, copper, lead, and zinc.

5.4 SUMMARY OF FATE AND TRANSPORT

The probabilistic model was used to quantify and summarize the available data and to estimate pre-remediation metals concentrations in surface water and mass loading to Moon Creek. Results are summarized in this section.

Surface water discharge, metals concentrations (total and dissolved), and mass loading data were analyzed using lognormal PDFs at one sampling location in Moon Creek. Only results for cadmium, lead, and zinc were analyzed. Regressions were developed for total and dissolved concentrations versus discharge to quantify and identify trends in concentrations and mass loading with changing discharge rates.

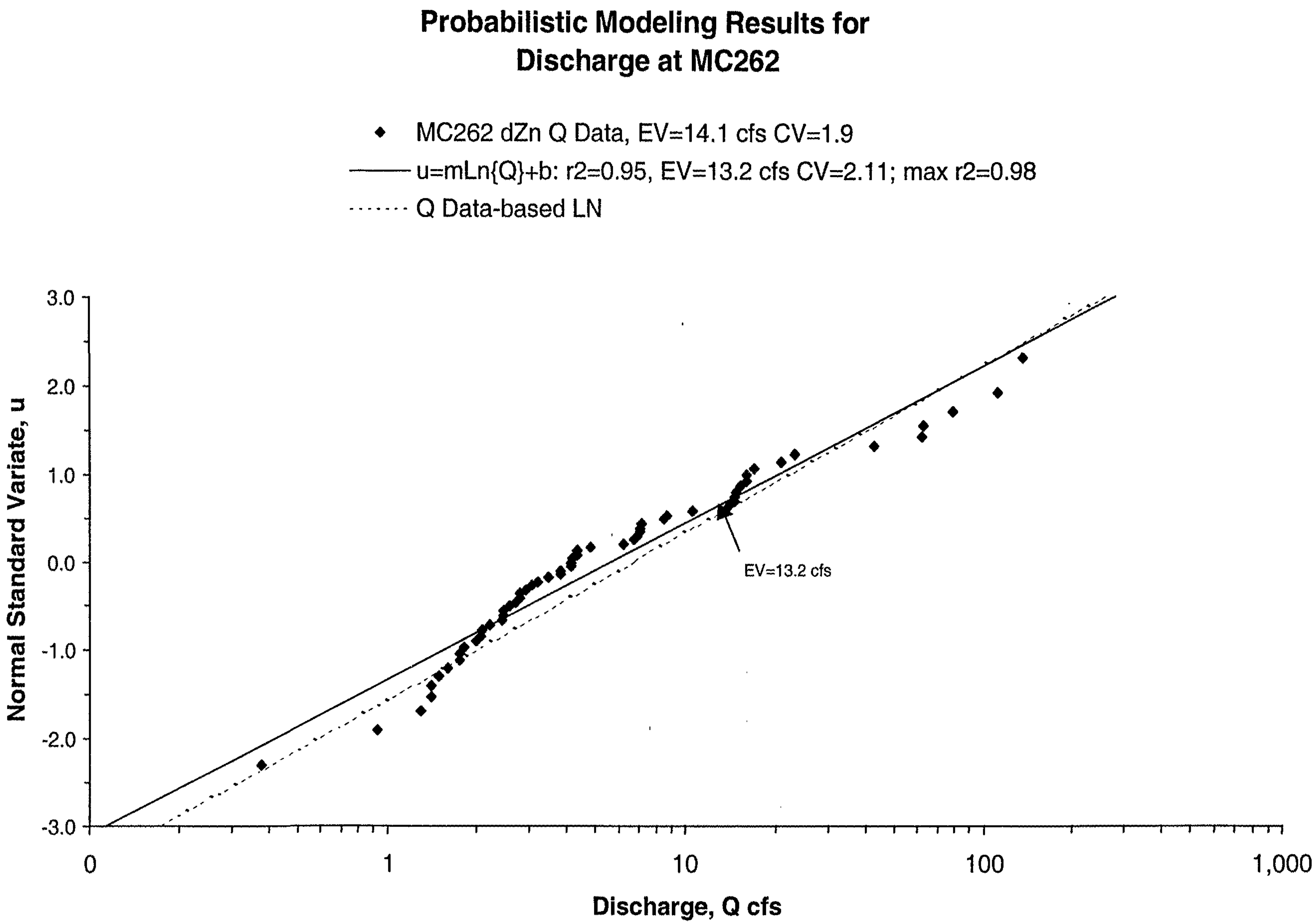
Results of the probabilistic modeling indicate:

- Estimated expected values of dissolved cadmium and zinc concentrations exceeded the screening levels. The estimated expected concentration of total lead was less than the screening level.

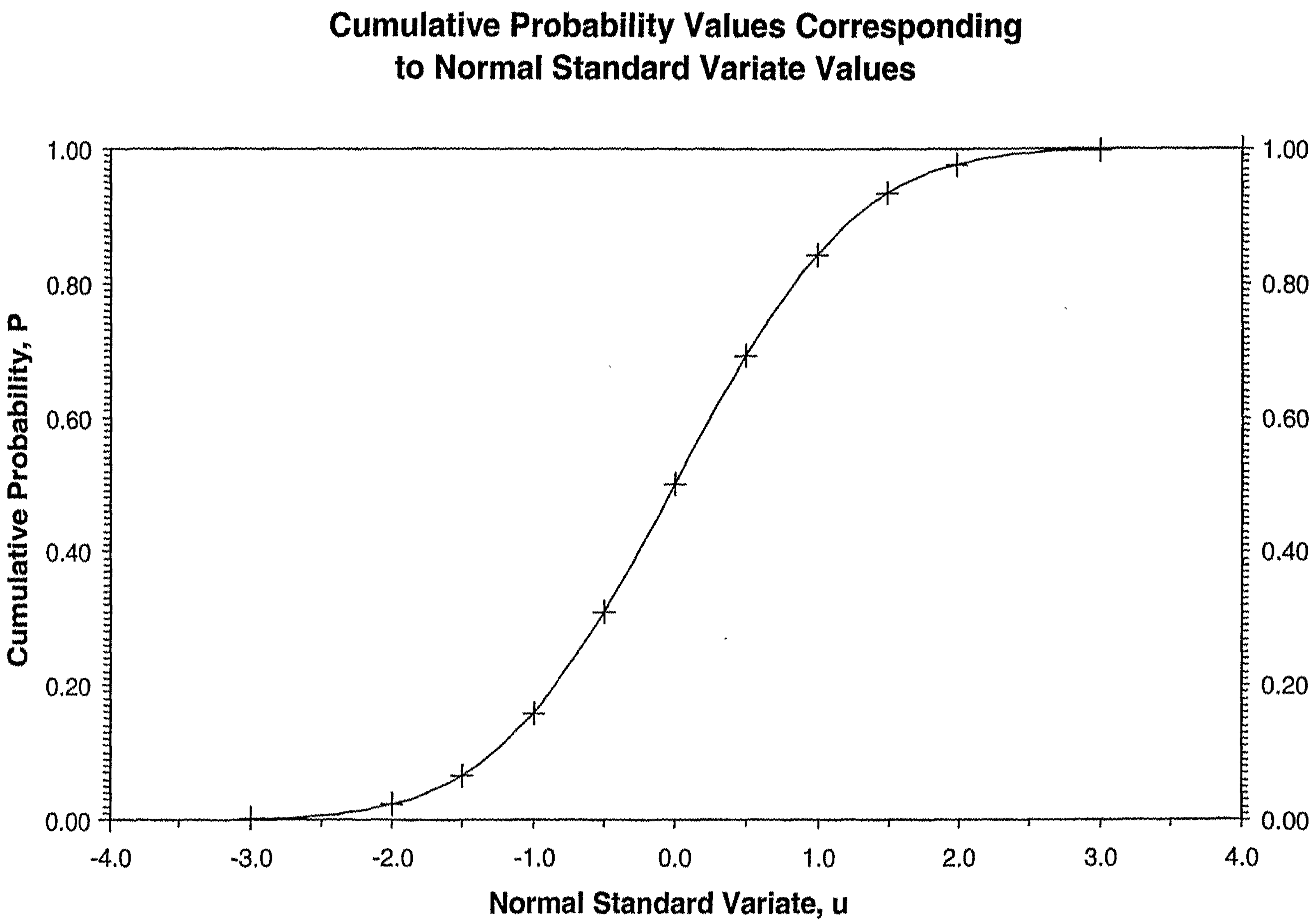
- Mass loading of cadmium and lead from Moon Creek into the South Fork were estimated to be minimal.

- Mass loading of dissolved zinc from Moon Creek into the South Fork was estimated to be 9.9 pounds/day.

- Potential sources of metals to Moon Creek include the Washington-Idaho Mine, Silver Crescent mine and mill complex and the Charles Dickens mine complex.



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Moon Creek Series 07/11/01	**Figure 5.2-1**



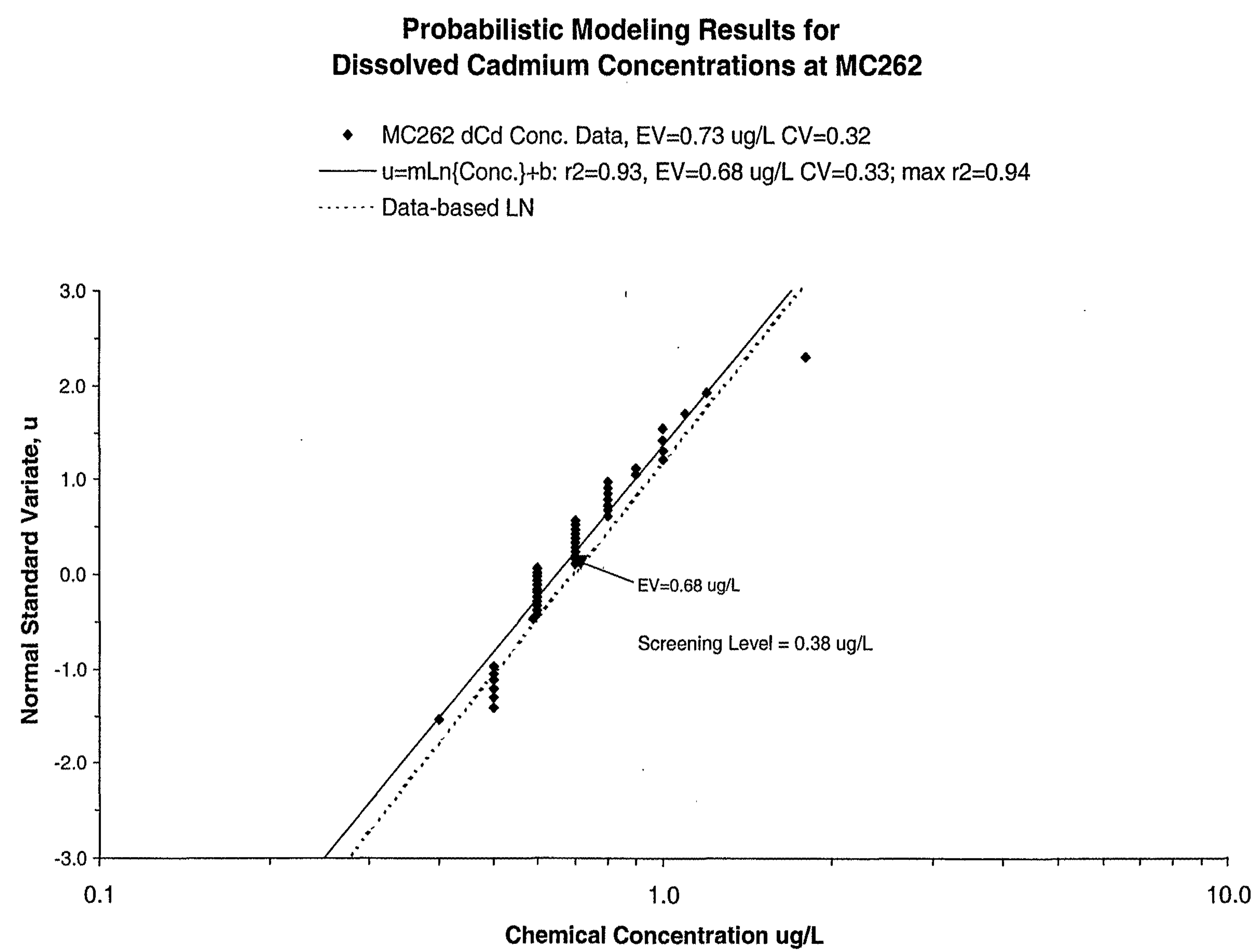
EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

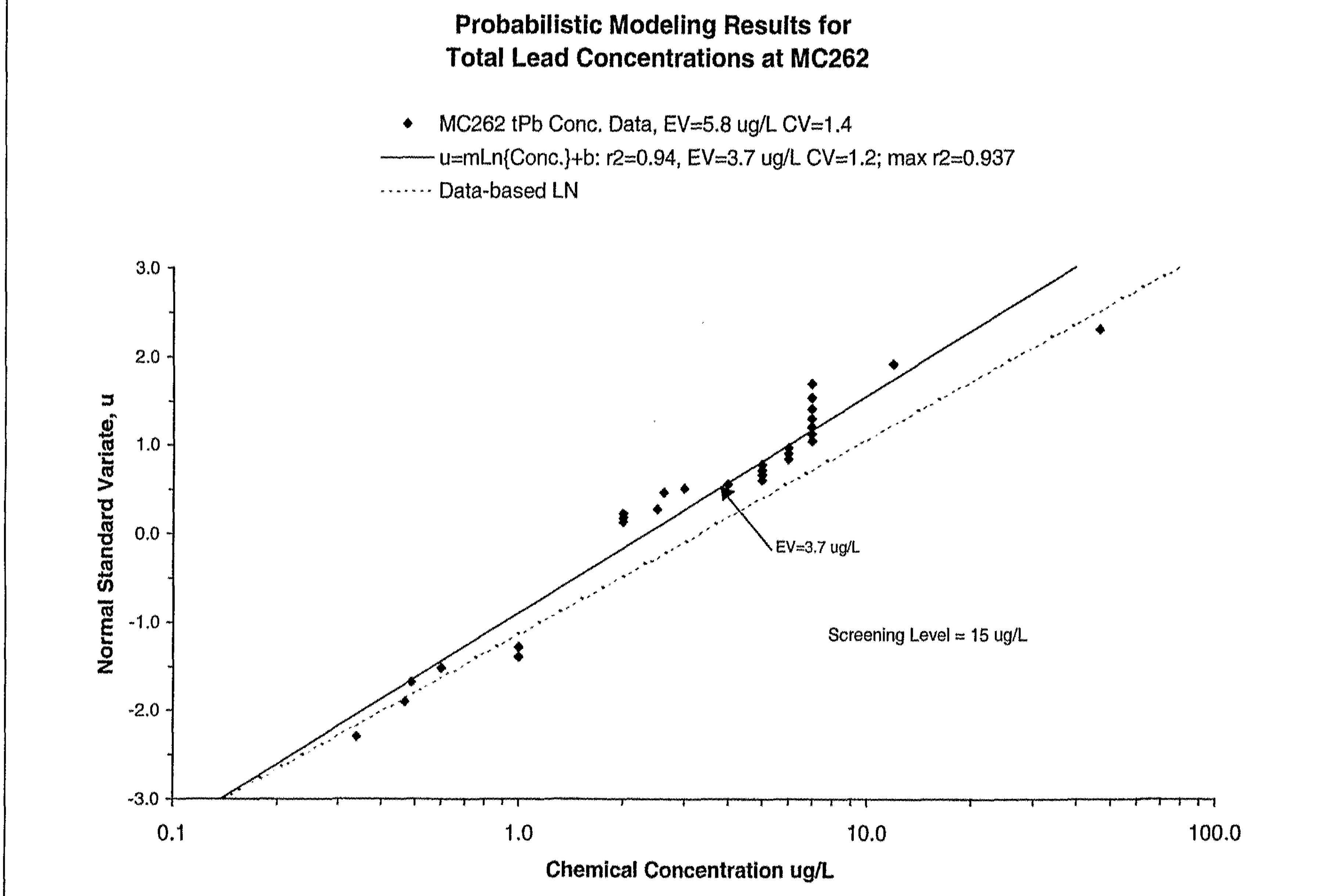
Doc Control: 4162500.6615.05.a
Generation: 1

Moon Creek Series
07/11/01

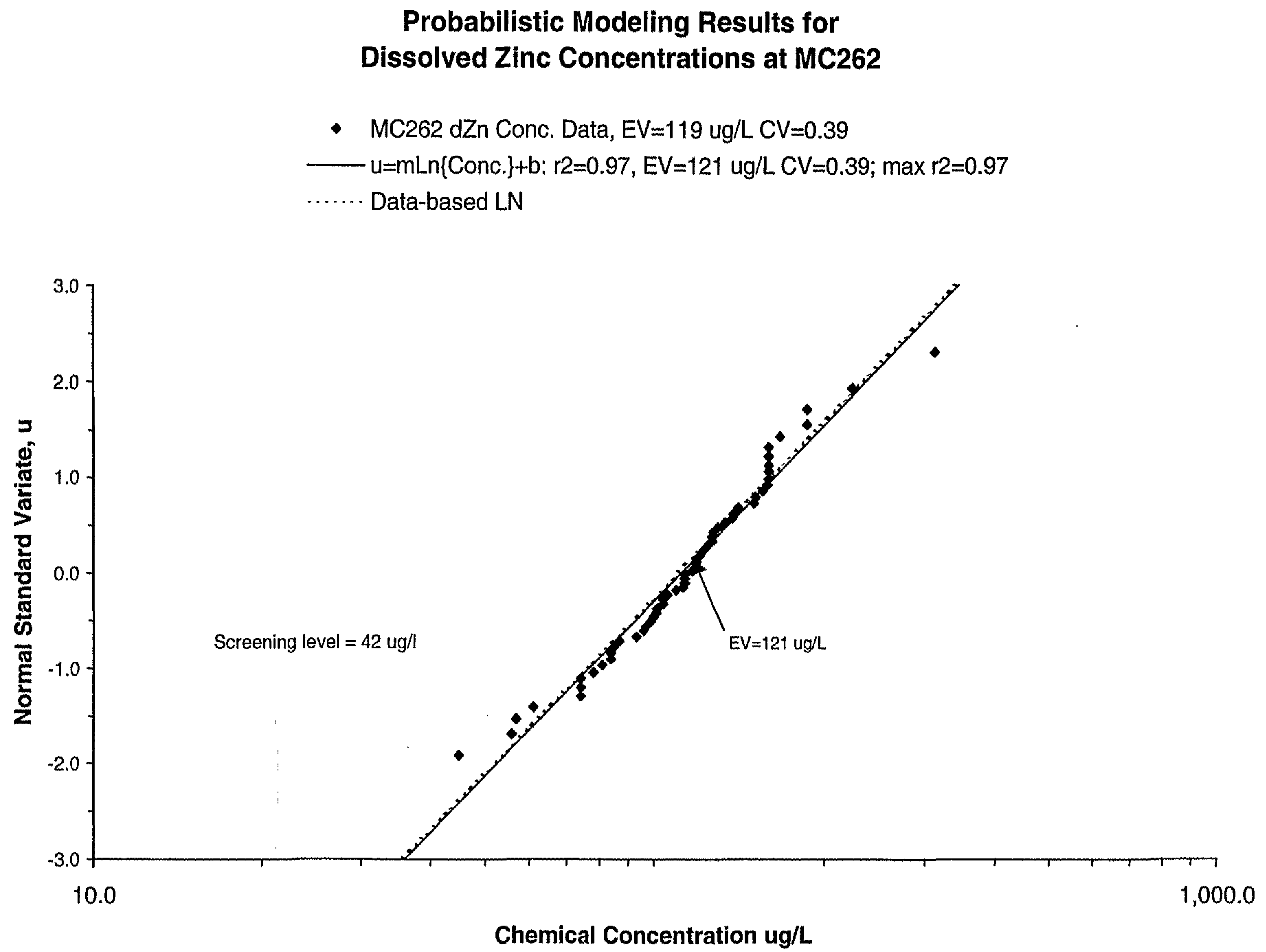
Figure 5.2-2



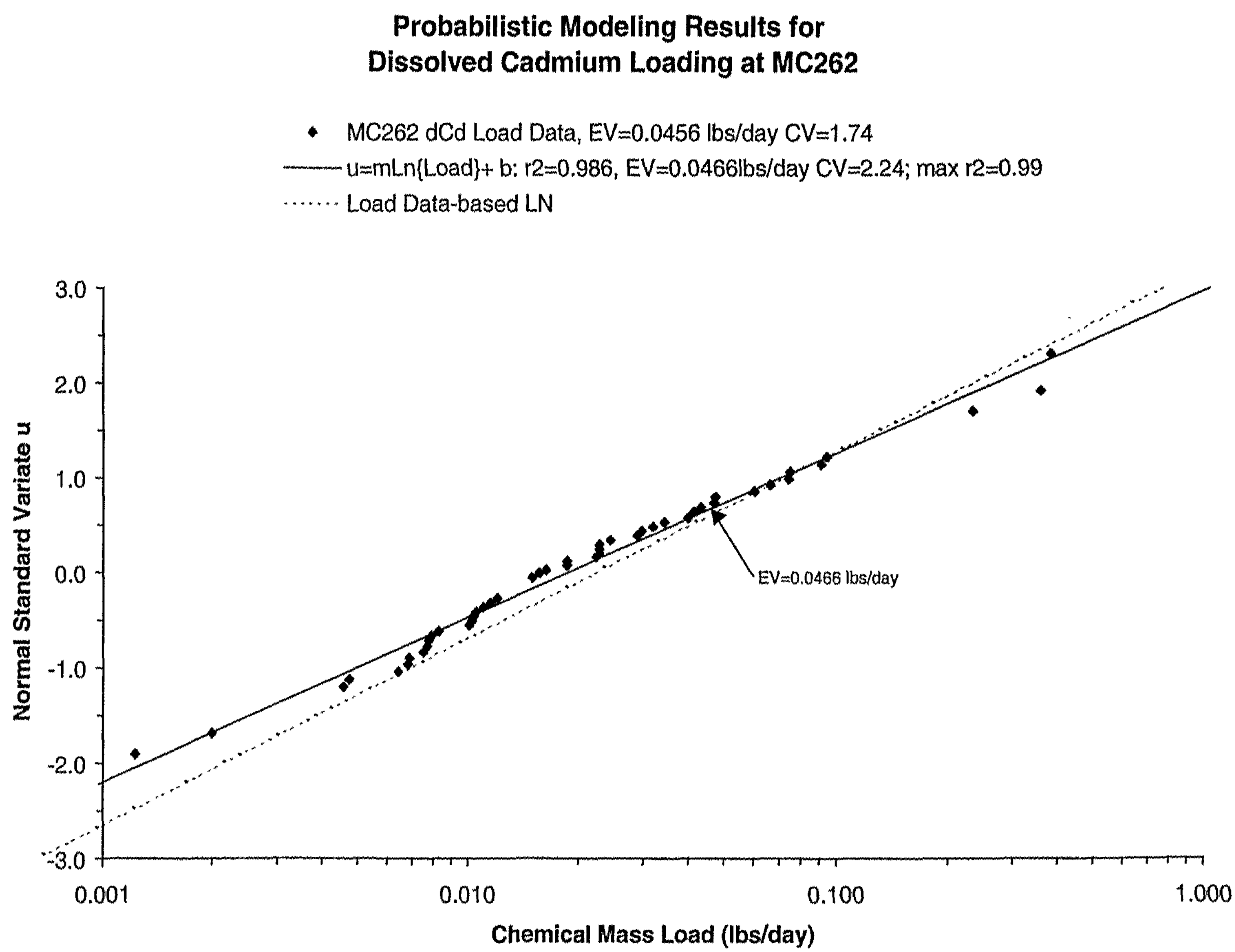
EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Moon Creek Series 07/11/01	**Figure 5.2-3**



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Moon Creek Series 07/11/01	Figure 5.2-4



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Moon Creek Series 07/11/01	Figure 5.2-5



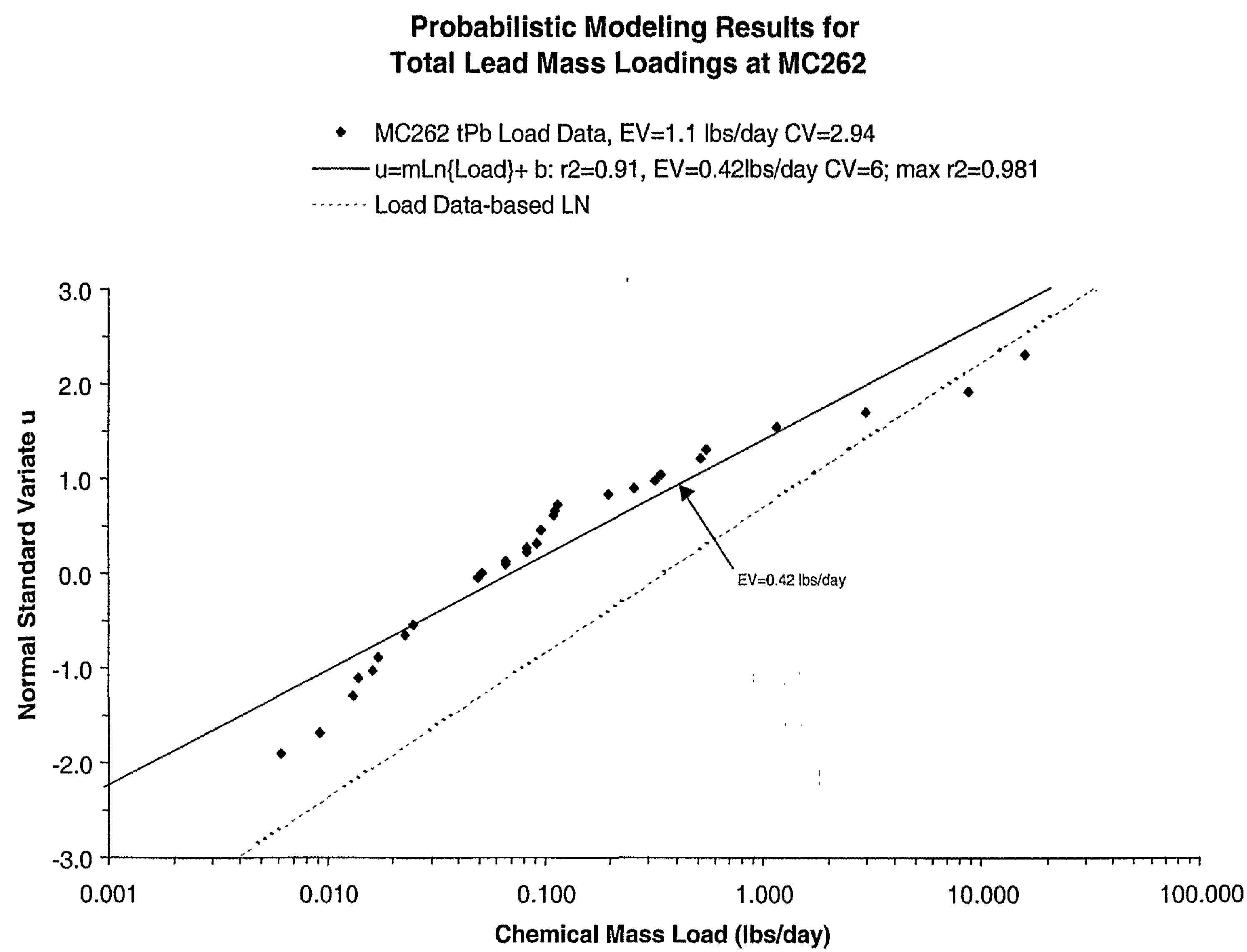
EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

Doc Control: 4162500.6615.05.a
Generation: 1

Moon Creek Series
07/11/01

Figure 5.2-6



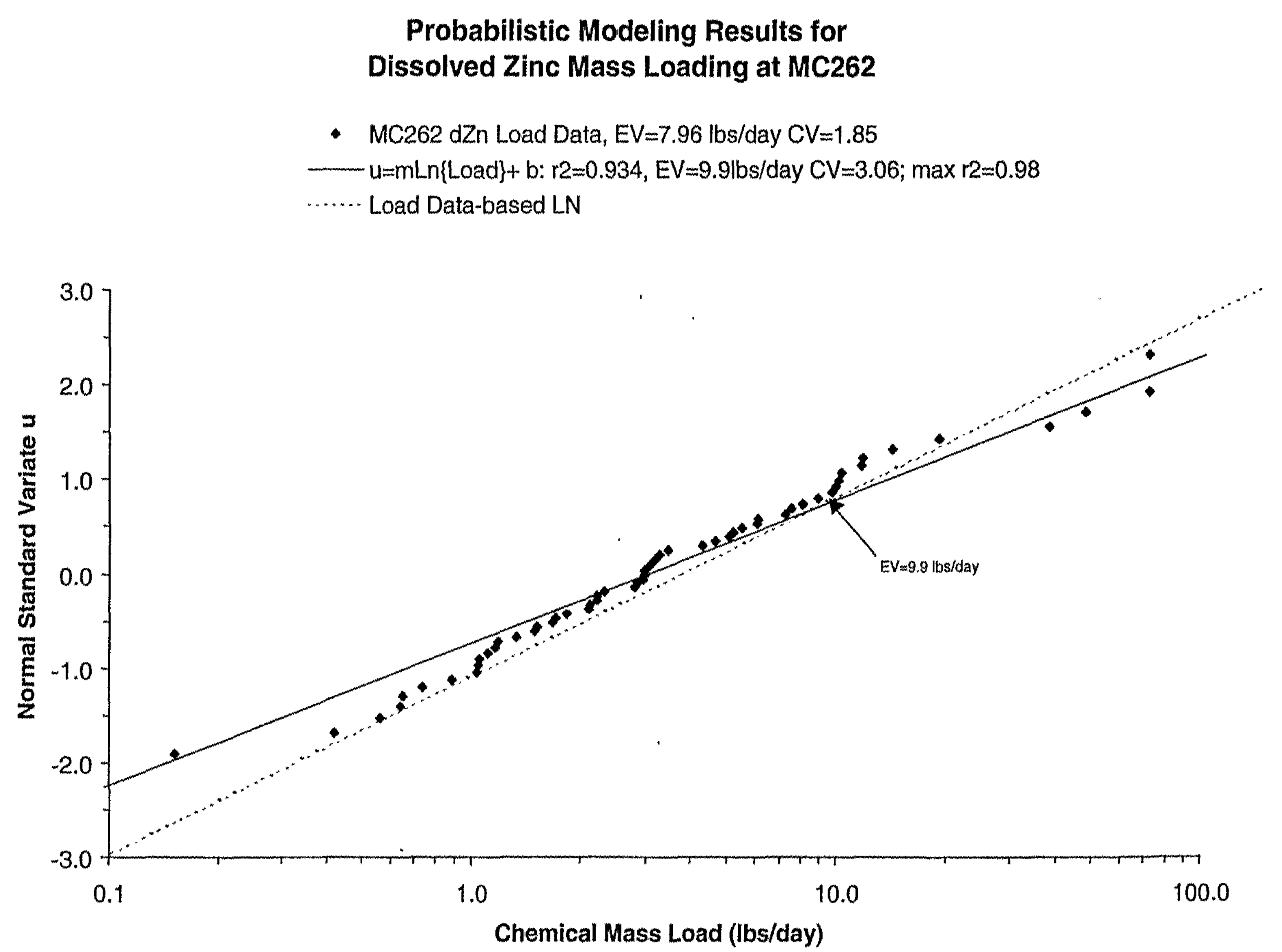
EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

Doc Control: 4162500.6615.05.a
Generation: 1

Moon Creek Series
07/11/01

Figure 5.2-7



EPA REGION 10	027-RI-CO-102Q Coeur d'Alene Basin RI/FS RI REPORT	Doc Control: 4162500.6615.05.a Generation: 1 Moon Creek Series 07/11/01	Figure 5.2-8

Table 5.1-1
Low and High Instantaneous Metal Loading Values for Six Sampling Events From May 1991 to May 1999

Metal	Low (pounds/day)	High (pounds/day)
Dissolved Cadmium	0.0002	0.388
Total Lead	0.006	3.02
Dissolved Lead	0.003	2.58
Dissolved Zinc	0.421	178.5

Table 5.2-1
Summary of Estimated Expected Values for Discharge, Metals Concentrations, and Mass Loading[a]

Sampling Location	Concentration (µg/L)			Mass Loading (pounds/day)			Discharge (cfs)
	Dissolved Cadmium	Total Lead	Dissolved Zinc	Dissolved Cadmium	Total Lead	Dissolved Zinc	
Screening Level	0.38	15	42	NA	NA	NA	NA
MC262	**0.68** (0.33)	3.7 (1.2)	**121** (0.39)	0.0466 (2.24)	0.42 (6)	9.9 (3.06)	13.2 (2.11)

[a]Summary tables with all modeling results are included in Appendix C.

Note:
cfs - cubic feet per second
µg/L - micrograms per liter
NA - not available
Values in parentheses are coefficients of variation.
Bold indicates exceedance of screening level

6.0 REFERENCES

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Section 5—Fate and Transport

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ATTACHMENT 1
Data Source References

Data Source References

Data Source References[a]	Data Source Name	Data Source Description	Reference
2	URS FSPA Nos. 1, 2, and 3	Fall 1997: Low Flow and Sediment Sampling	URS Greiner Inc. 1997. Field Sampling Plan Addendum 1 Sediment Coring in the Lower Coeur d'Alene River Basin, Including Lateral Lakes and River Floodplains
			URS Greiner Inc. 1997. Field Sampling Plan Addendum 2 Adit Drainage, Seep and Creek Surface Water Sampling
			URS Greiner Inc. 1997. Field Sampling Plan Addendum 3 Sediment Sampling Survey in the South Fork of the Coeur d'Alene River, Canyon Creek, and Nine-Mile Creek
3	URS FSPA No. 4	Spring 1998: High Flow Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 4 Adit Drainage, Seep and Creek Surface Water Sampling; Spring 1998 High Flow Event
4	MFG Historical Data Spring 1991	Spring 1991: High Flow Sampling	McCulley, Frick & Gillman, Inc. 1991. Upstream Surface Water Sampling Program Spring 1991 High Flow Event, South Fork Coeur d'Alene River Basin above Bunker Hill Superfund Site: Tables 1 and 2
5	MFG Historical Data Fall 1991	Fall 1991: Low Flow Sampling	McCulley, Frick & Gillman, Inc. 1992. Upstream Surface Water Sampling Program Fall 1991 Low Flow Event, South Fork Coeur d'Alene River Basin above Bunker Hill Superfund Site: Tables 1 and 2
6	EPA/Box Historical Data	Superfund Site Groundwater and Surface Water Data	CH2MHill. 1997. Location of Wells and Surface Water Sites, Bunker Hill Superfund Site. Fax Transmission of Map August 11, 1998
			Environmental Protection Agency. 1998. E-mail from Ben Cope July 15, 1998. Subject: 2 Datasets File Attached: BOXDATA.WK4
7	IDEQ Historical Data	IDEQ Water Quality Data	Idaho Department of Environmental Quality. 1998. Assortment of files from Glen Pettit for water years 1993 through 1996
			Idaho Department of Environmental Quality. 1998. E-mail from Glen Pettit October 6, 1998 Subject: DEQ Water Quality Data Files Attached: 1998 trend Samples.xls, 1997 trend Samples.xls

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
8	EPA/NPDES Historical Data	Water Quality based on NPDES Program	Environmental Protection Agency. 1998. E-mail from Ben Cope August 11, 1998/September 2, 1998. Subject: Better PCS Data Files/Smelterville. Attached: PCS2.WK4, PCSREQ.698/TMT-PLAN.XLS
			Environmental Protection Agency. 1998. E-mail from Ben Cope August 5, 1998. Subject: State of Idaho Lat/Longs File Attached: PAT.DBF
			Environmental Protection Agency. 1998. E-mail from Ben Cope July 15, 1998. Subject: 2 Datasets File Attached: PCSDATA.WK4
10	URS FSPA No. 5	Common Use Areas Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 5 Common Use Areas: Upland Common Use Areas and Lower Basin Recreational Beaches; Sediment/Soil, Surface Water, and Drinking Water Supply Characterization
11	URS FSPA No. 8	Source Area Sampling	URS Greiner Inc. 1998. Field Sampling Plan Addendum 8 Tier 2 Source Area Characterization Field Sampling Plan
12	Historical Groundwater Data from MFG	1997 Annual Groundwater Data Report Woodland Park	McCulley, Frick & Gillman. 1998. 1997 Annual Groundwater Data Report Woodland Park
13	Historical Data from US Forest Service, Idaho Geological Survey and others	Historical Data on Inactive Mine Sites USFS, IGS and CCJM, 1994-1997, Prichard Creek, Pine Creek and Summit Mining District	Mackey K, Yarbrough, S.L. 1995. Draft Removal Preliminary Assessment Report Pine Creek Millsites, Coeur d'Alene District, Idaho, Contract No. 1422-N651-C4-3049
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. I, Prichard Creek and Eagle Creek Drainages
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. III, Coeur d'Alene River Drainage Surrounding the Coeur d'Alene Mining District (Excluding the Prichard Creek and Eagle Creek Drainages)

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
			Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. IV, Prichard Creek and Eagle Creek Drainages
13	Historical Data from US Forest Service, Idaho Geological Survey and others (continued)		Idaho Geological Survey. 1999. Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Forest Service Lands (Region 1), Idaho Panhandle National Forest Vol. V, Coeur d'Alene River Drainage Surrounding the Coeur d'Alene Mining District (Excluding the Prichard Creek and Eagle Creek Drainages) Part 2 Secondary Properties
			US Forest Service. 1995. Pilot Inventory of Inactive and Abandoned Mine Lands, East Fork Pine Creek Watershed, Shoshone County, Idaho
14	Historical Sediment Core Data: University of Idaho (Thesis papers)	Historical Lateral Lakes Sediment Data from F. Rabbi and M.L. Hoffman	Characterization of Heavy Metal Contamination in Two Lateral Lakes of the Lower Coeur d'Alene River Valley, A thesis by M.L. Hoffmann, May 1995
			Trace Element Geochemistry of Bottom Sediments and Waters from the Lateral Lakes of Coeur d'Alene River, A Dissertation by F. Rabbi, May 1994
15	URS FSPA No. 9	Source Area Characterization; Field XRF Data	CH2M Hill and URS Greiner. 1998. Field Sampling Plan Addendum 9 Delineation of Contaminant Source Areas in the Coeur d'Alene Basin using Survey and Hyperspectral Imaging Techniques
16	Historical Sediment Data	Electronic Data compiled by USGS	U.S. Geological Survey. 1992. Effect of Mining-Related Activities on the Sediment-Trace Element Geochemistry of Lake Coeue d'Alene, Idaho, USA--Part 1: Surface Sediments, USGS Open-File Report 92-109, Prepared by A.J. Horowitz, K.A. Elrick, and R.B. Cook
			US Geological Survey. 2000. Chemical Analyses of Metal-Enriched Sediments, Coeur d'Alene Drainage Basin, Idaho: Sampling, Analytical Methods, and Results. Draft. October 13, 2000. Prepared by S.E. Box, A.A. Bookstrom, M. Ikramuddin, and J. Lindsey. Samples collected from 1993 to 1998.

Data Source References (Continued)

Data Source References*	Data Source Name	Data Source Description	Reference
17	USGS Spokane River Basin Sediment Samples	Surface Sediment Samples Collected by USGS in the Spokane River Basin	Environmental Protection Agency. 1999. Data Validation Memorandum and Attached Table from Laura Castrilli to Mary Jane Nearman dated June 9, 1999. Subject: Coeur d'Alene (Bunker Hill) Spokane River Basin Surface Sample Samples, USGS Metals Analysis, <63 um fraction, Data Validation, Samples SRH7-SRH30
18	USGS Snomelt Surface Water Data	Surface Water Data from 1999 Snomelt Runoff Hydrograph	USGS. 1999. USGS WY99.xls Spreadsheet dowloaded from USGS (Coeur d'Alene Office) ftp site
			USGS. 2000. Concentrations and Loads of Cadmium, Lead and Zinc Measured near the Peak of the 1999 Snomelt Runoff Hydrograph at 42 Stations, Coeur d'Alene River Basin Idaho
			USGS. 2000. Concentrations and Loads of Cadmium, Lead and Zinc Measured on the Ascending and Descending Limbs of the 1999 Snomelt Runoff Hydrograph at Nine Stations, Coeur d'Alene River Basin Idaho
22	MFG Report on Union Pacific Railroad Right-of-Way Soil Sampling	Surface and Subsurface Soil Lead Data	MFG. 1997. Union Pacific Railroad Wallace Branch, Rails to Trails Conversion, Right-of-Way Soil Sampling, Summary and Interpretation of Data. McCulley, Frick and Gilman, Inc. March 14, 1997
23	URS FSPA No. 11A	Source Area Groundwater and Surface Water Sampling	URS Greiner Inc. 1999. Field Sampling Plan Addendum 11A Tier 2 Source Area Characterization
24	URS FSPA No. 15	Common Use Area Sampling—Spokane River	URS Greiner Inc. 1999. Field Sampling Plan Addendum 15 Spokane River - Washington State Common Use Area Sediment Characterization
25	URS FSPA No. 18	Depositional and Common Use Area Sediment Sampling - Spokane River	URS Greiner Inc. 2001. Final Field Sampling Plan Addendum No. 18, Fall 2000 Field Screening of Sediment in Spokane River Depositional Areas, Summary of Results. Revision 1. January 2001.

Data Source References (Continued)

Data Source References[a]	Data Source Name	Data Source Description	Reference
28	USGS National Water Quality Assessment database	Surface water data for sampling location NF50 at Enaville, Idaho	USGS. 2001. USGS National Water Quality Assessment database: http://infotrek.er.usgs.gov/pls/nawqa/nawqa.wwv_main.gohome. Data retrieved on August 2, 2001 for station 12413000, NF Coeur d'Alene River At Enaville, Idaho.

[a]Reference Number is the sequential number used as cross reference to associate chemical results in data summary tables with specific data collection efforts.

ATTACHMENT 2
Data Summary Tables

ABBREVIATIONS USED IN DATA SUMMARY TABLE

LOCATION TYPES:

AD adit
BH borehole
FP flood plain
GS ground surface/near surface
HA hand auger boring
LK lake/pond/open reservoir
OF outfall/discharge
RV river/stream
SP stockpile
TL tailings pile

QUALIFIERS:

U Analyte was not detected above the reported detection limit
J Estimated concentration

DATA SOURCE REFERENCES:

Data source references listed in Attachment 1 are included in these tables in the "Ref" column.

Data Summary Table
Moon Creek - segment MoonCrkSeg01

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
MC8266	TL	13	—			$\boxed{410}$	$\boxed{13}$	87	44000	$\boxed{1200}$	830			$\boxed{1100}$

Data Summary Table
Moon Creek - segment MoonCrkSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Soil (mg/kg)														
MC8161	TL	13	---			1300	110	1400	110000	11000	73			16000
MC8162	TL	13	---			960	3	390	41000	8600	140			1000
MC8265	TL	13	---			1700	4.9	260	82000	480	110			230
Surface Water - Total Metals (ug/l)														
MC262	RV	2	11/05/1997		0.28 U	0.42	0.56	1.2	5 U	0.47 J	1.8 J	0.1 U	0.22 U	135
MC262	RV	4	05/14/1991				0.5			4				113
MC262	RV	5	10/01/1991				0.5			5				158
MC262	RV	7	10/29/1993				0.6			2.5 U				152
MC262	RV	7	12/01/1993				0.7			2.5 U				157
MC262	RV	7	12/21/1993				0.7			7				178
MC262	RV	7	01/21/1994				0.5 J			2.5 U				155
MC262	RV	7	02/17/1994				0.8			2.5 U				156
MC262	RV	7	03/07/1994				0.5 J			2.5 U				116
MC262	RV	7	03/23/1994				0.5 J			2.5 U				117
MC262	RV	7	04/06/1994				0.6			2.5 U				106
MC262	RV	7	04/18/1994				0.6			2.5 U				97
MC262	RV	7	05/03/1994				0.6			2.5 U				101
MC262	RV	7	05/20/1994				0.8			2.5 U				125
MC262	RV	7	06/07/1994				0.7			2.5 U				137
MC262	RV	7	06/24/1994				0.7			2.5 U				125
MC262	RV	7	07/22/1994				0.8			2.5 U				103
MC262	RV	7	08/17/1994				0.8			2.5 U				74
MC262	RV	7	09/26/1994				0.25 U			2.5 U				96
MC262	RV	7	10/05/1994				0.5 J			2.5 U				88
MC262	RV	7	11/16/1994				0.5 J			2.5 U				151
MC262	RV	7	12/14/1994				0.7			2.5 U				162
MC262	RV	7	01/10/1995				0.5 J			2.5 U				160
MC262	RV	7	02/09/1995				0.6			2.5 U				113
MC262	RV	7	03/08/1995				0.6			2.5 U				127
MC262	RV	7	03/22/1995				0.9			7				120
MC262	RV	7	04/12/1995				0.8			6				128
MC262	RV	7	04/25/1995				1.2			7				117
MC262	RV	7	05/09/1995				1			7				153
MC262	RV	7	05/23/1995				1.1			2.5 U				127
MC262	RV	7	06/12/1995				0.8			5 J				137

Data Summary Table
Moon Creek - segment MoonCrkSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Total Metals (ug/l)														
MC262	RV	7	06/27/1995				0.6			7				105
MC262	RV	7	07/11/1995				0.8			2.5 U				130
MC262	RV	7	07/25/1995				0.7			6				109
MC262	RV	7	08/14/1995				0.6			5 J				118
MC262	RV	7	09/13/1995				0.6			7				113
MC262	RV	7	10/18/1995				1			5 J				183
MC262	RV	7	11/21/1995				0.7			6				164
MC262	RV	7	12/27/1995				1			2.5 U				157
MC262	RV	7	01/17/1996				0.7			12				124
MC262	RV	7	02/28/1996				0.5 J			6				111
MC262	RV	7	03/27/1996				0.25 U			2.5 U				122
MC262	RV	7	04/17/1996				0.5 J			10				169
MC262	RV	7	05/08/1996				0.5 J			8				129
MC262	RV	7	06/19/1996				0.6			5 J				111
MC262	RV	7	07/24/1996				0.6			6				99
MC262	RV	7	08/21/1996				0.7			15				96
MC262	RV	7	09/26/1996				0.6			2.5 U				103
MC262	RV	7	10/29/1996				0.7			5				122
MC262	RV	7	11/26/1996				0.6			7				145
MC262	RV	7	12/13/1996				0.6			2.5				144
MC262	RV	7	01/29/1997				0.6			2.5				163
MC262	RV	7	02/21/1997				0.5			6				122
MC262	RV	7	03/26/1997				0.9			0.06				178
MC262	RV	7	04/16/1997							26				145
MC262	RV	7	04/16/1997				0.7							
MC262	RV	7	06/23/1997				0.5			8				95
MC262	RV	7	07/23/1997				0.8			7				143
MC262	RV	7	08/14/1997				0.6			2.5				119
MC262	RV	7	09/03/1997				0.25			2.5				82
MC262	RV	7	10/16/1997				0.7			2.5				132
MC262	RV	7	11/24/1997				0.7			2.5				135
MC262	RV	7	12/17/1997				0.7			2.5				168
MC262	RV	7	01/21/1998				0.7			4				158
MC262	RV	7	02/25/1998				0.25			2.5				109
MC262	RV	7	03/20/1998				0.5			2.5				119
MC262	RV		04/23/1998				0.6			2.5				132
MC262	RV	18	10/28/1998				1			2				120

Data Summary Table
Moon Creek - segment MoonCrkSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Total Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
MC262	RV	18	11/18/1998				1 UJ			2				120
MC262	RV	18	12/14/1998				1 UJ			2				160
MC262	RV	18	01/21/1999				1 UJ			3				100
MC262	RV	18	03/22/1999				1 UJ			47				110
MC262	RV	18	04/20/1999				1 UJ			5				40
MC262	RV	18	05/04/1999							1				60
MC262	RV	18	05/23/1999						30		2			70
MC262	RV	18	06/16/1999							1				70
MC262	RV	18	07/20/1999							0.49				90.5
MC262	RV	18	08/04/1999							0.34				78
MC262	RV	18	08/31/1999							0.6				82.9
MC262	RV	7	05/28/1998				0.5 U			12				105
MC262	RV	7	06/25/1998				0.6			5 U				134
MC262	RV	7	07/27/1998				0.6			5 U				90
MC262	RV	7	08/25/1998				0.5			6				98
MC262	RV	7	09/24/1998				0.5 U			5 U				109
MC262	RV	7	10/26/1998				0.5			5 U				98
MC262	RV	7	11/24/1998				0.9			5 U				131
MC262	RV	7	12/31/1998				0.7			7				96
MC262	RV	7	01/15/1999				2.4			14				104
MC262	RV	7	02/22/1999				0.9			5 U				126
MC262	RV	7	03/08/1999				0.6			5 U				119
MC262	RV	3	05/05/1998		0.3	2 U	1.9	2 U	38	2.6	10	0.2 U	0.2 U	316
MC8122	SP	13	—			29 U	7	35 U	12 U	15 U	4	5 U		3 U
MC8123	AD	13	—			23	6	35 U	300	15 U	150	5 U		30
MC8124	RV	13	—			29 U	5	35 U	12	3.1	12	5 U		330

Surface Water - Dissolved Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
MC262	RV	2	11/05/1997		0.5 U	0.42	0.59	0.84	10 U	0.23	1	0.2 U	0.03 U	130
MC262	RV	4	05/14/1991				0.5			3 U				102
MC262	RV	5	10/01/1991				0.4			1 U				84
MC262	RV	7	10/29/1993				0.6			1.5 U				160
MC262	RV	7	12/01/1993				0.7			1.5 U				160
MC262	RV	7	12/21/1993				0.7			1.5 U				187
MC262	RV	7	01/21/1994				0.6			1.5 U				160
MC262	RV	7	02/17/1994				0.8			1.5 U				156
MC262	RV	7	03/07/1994				0.6			1.5 U				114

Data Summary Table
Moon Creek - segment MoonCrkSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X	Shaded Sample Results Exceed Screening Level By More Than 10X
	Shaded Results With (*) Exceed Screening Level By More Than 100X

Surface Water - Dissolved Metals (ug/l)

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
MC262	RV	7	03/23/1994				0.5 J			1.5 U				119
MC262	RV	7	04/06/1994				1			1.5 U				101
MC262	RV	7	04/18/1994				0.6			1.5 U				97
MC262	RV	7	05/03/1994				0.9			1.5 U				104
MC262	RV	7	05/20/1994				0.8			1.5 U				127
MC262	RV	7	06/07/1994				0.8			1.5 U				141
MC262	RV	7	06/24/1994				0.8			1.5 U				121
MC262	RV	7	07/22/1994				0.6			1.5 U				104
MC262	RV	7	08/17/1994				0.6			2.5 J				74
MC262	RV	7	09/26/1994				0.6			1.5 U				87
MC262	RV	7	10/05/1994				0.5 J			1.5 U				78
MC262	RV	7	11/16/1994				0.5 J			1.5 U				152
MC262	RV	7	12/14/1994				0.8			1.5 U				159
MC262	RV	7	01/10/1995				0.7			1.5 U				160
MC262	RV	7	02/09/1995				0.7			1.5 U				114
MC262	RV	7	03/08/1995				0.6			1.5 U				120
MC262	RV	7	03/22/1995				0.9			6				113
MC262	RV	7	04/12/1995				0.7			1.5 U				117
MC262	RV	7	04/25/1995				1.2			3 J				114
MC262	RV	7	05/09/1995				0.8			4				128
MC262	RV	7	05/23/1995				1.1			3 J				125
MC262	RV	7	06/12/1995				0.7			4				134
MC262	RV	7	06/27/1995				0.7			1.5 U				96
MC262	RV	7	07/11/1995				0.7			1.5 U				139
MC262	RV	7	07/25/1995				0.7			3 J				106
MC262	RV	7	08/14/1995				0.7			80				226
MC262	RV	7	09/13/1995				0.8			4				110
MC262	RV	7	10/18/1995				0.9			2.5 J				174
MC262	RV	7	11/21/1995				0.6			3 J				164
MC262	RV	7	12/27/1995				0.8			1.5 U				149
MC262	RV	7	01/17/1996				0.7			4				109
MC262	RV	7	02/28/1996				0.5 J			3 J				125
MC262	RV	7	03/27/1996				0.5 J			1.5 U				198
MC262	RV	7	04/17/1996				0.5 J			3 J				154
MC262	RV	7	05/08/1996				0.6			4				125
MC262	RV	7	06/19/1996				0.6			3 J				144
MC262	[illegible]	7	07/24/1996				0.6			1.5 U				93

Data Summary Table
Moon Creek - segment MoonCrkSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
MC262	RV	7	08/21/1996				**0.6**			**4**				**86**
MC262	RV	7	09/26/1996				**0.7**			1.5 U				**110**
MC262	RV	7	10/29/1996				**0.7**			0.15				**115**
MC262	RV	7	11/26/1996				**0.6**			0.15				**146**
MC262	RV	7	12/13/1996				**0.6**			**1.5**				**152**
MC262	RV	7	01/29/1997				**0.6**			**1.5**				**129**
MC262	RV	7	02/21/1997				**0.5**			**1.5**				**120**
MC262	RV	7	03/26/1997				**0.6**			**6**				**106**
MC262	RV	7	04/16/1997				**0.6**			**4**				**105**
MC262	RV	7	06/23/1997				**0.5**			**2.5**				**166**
MC262	RV	7	07/23/1997				**0.8**			**3**				**156**
MC262	RV	7	08/14/1997				**0.6**			**3**				**111**
MC262	RV	7	09/03/1997				**0.5**			**3**				**92**
MC262	RV	7	10/16/1997				**0.7**			**1.5**				**120**
MC262	RV	7	11/24/1997				**0.7**			**1.5**				**132**
MC262	RV	7	12/17/1997				**0.7**			**1.5**				**154**
MC262	RV	7	01/21/1998				**0.5**			**1.5**				**142**
MC262	RV	7	02/25/1998				**0.5**			**1.5**				**110**
MC262	RV	7	03/20/1998				**0.5**			**1.5**				**111**
MC262	RV	7	04/23/1998				**0.6**			**1.5**				**151**
MC262	RV	18	10/28/1998				1 UJ			**1.4**				**127**
MC262	RV	18	11/18/1998				1 UJ			1				**123**
MC262	RV	18	12/14/1998				1 UJ			1				**167**
MC262	RV	18	01/21/1999				0.001 UJ			0.001				0.101
MC262	RV	18	03/22/1999				1 UJ			1				**57**
MC262	RV	18	04/20/1999				1 UJ			1				**45**
MC262	RV	18	05/04/1999				**1**			1				**56**
MC262	RV	18	05/23/1999				**1**		10	1	1.6			**61**
MC262	RV	18	06/16/1999				**1**			1				**74**
MC262	RV	18	07/20/1999				1 U			1 U				**93**
MC262	RV	18	08/04/1999				1 U			1 U				**81**
MC262	RV	18	08/31/1999				1 U			1 U				**85**
MC262	RV	7	05/28/1998				0.5 U			3 U				**99**
MC262	RV	7	06/25/1998				**0.6**			3 U				**138**
MC262	RV	7	07/27/1998				**0.6**			3 U				**87**
MC262	RV	7	08/25/1998				**0.5**			3 U				**84**
MC262	RV	7	09/24/1998				0.5 U			3 U				**100**

Data Summary Table
Moon Creek - segment MoonCrkSeg02

Boxed Sample Results Exceed Screening Level By More Than 1X

Shaded Sample Results Exceed Screening Level By More Than 10X

Shaded Results With (*) Exceed Screening Level By More Than 100X

Location	Location Type	Ref	Date	Depth In Feet	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
Surface Water - Dissolved Metals (ug/l)														
MC262	RV	7	10/26/1998				0.5			3 U				87
MC262	RV	7	11/24/1998				0.9			3 U				130
MC262	RV	7	12/31/1998				0.8			3 U				99
MC262	RV	7	01/15/1999				1			3 U				94
MC262	RV	7	02/22/1999				0.9			3 U				125
MC262	RV	7	03/08/1999				0.7			3 U				113
MC262	RV	3	05/05/1998		0.3	2 U	1.8	2	20 U	1	11	0.2 U	0.2 U	318
MC8122	SP	13	—				2.3 U	8.4 U	3.7 U		1.2 U			2.8
MC8123	AD	13	—				2.3 U		250		130			21
MC8123	AD	13	—					8 U						
MC8124	RV	13	—				3.7		3.7 U		8.1			340
MC8124	RV	13	—					8 U						

ATTACHMENT 3
Statistical Summary Tables for Metals

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment MoonCrkSeg01
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Arsenic	1	1	410	410	410	< 0.001	22	1	1	0
Cadmium	1	1	13	13	13	< 0.001	9.8	1	0	0
Copper	1	1	87	87	87	< 0.001	100	0	0	0
Iron	1	1	44,000	44,000	44,000	< 0.001	65,000	0	0	0
Lead	1	1	1,200	1,200	1,200	< 0.001	171	1	0	0
Manganese	1	1	830	830	830	< 0.001	3,597	0	0	0
Zinc	1	1	1,100	1,100	1,100	< 0.001	280	1	0	0

Statistical Summary of Total Metals Concentrations in Surface Soil
Segment MoonCrkSeg02
Units: mg/kg

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Arsenic	3	3	960	1,700	1,320	0.28	22	3	3	0
Cadmium	3	3	3	110	39.3	1.56	9.8	1	1	0
Copper	3	3	260	1,400	683	0.91	100	3	1	0
Iron	3	3	41,000	110,000	77,700	0.45	65,000	2	0	0
Lead	3	3	480	11,000	6,690	0.82	171	3	2	0
Manganese	3	3	73	140	108	0.31	3,597	0	0	0
Zinc	3	3	230	16,000	5,740	1.55	280	2	1	0

Statistical Summary of Total Metals Concentrations in Surface Water
Segment MoonCrkSeg02
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	2	1	0.3	0.3	0.3	< 0.001	6	0	0	0
Arsenic	5	2	0.42	23	11.7	1.37	50	0	0	0
Cadmium	87	78	0.25	7	0.908	1.19	2	4	0	0
Copper	5	1	1.2	1.2	1.2	< 0.001	1	1	0	0
Iron	6	4	12	300	95	1.44	300	0	0	0
Lead	92	57	0.06	47	6.03	1.16	15	2	0	0
Manganese	6	6	1.8	150	30	1.97	50	1	0	0
Zinc	93	92	30	330	125	0.34	30	91	2	0

Statistical Summary of Dissolved Metals Concentrations in Surface Water
Segment MoonCrkSeg02
Units: ug/L

Analyte Name	Quantity Tested	Quantity Detected	Minimum Detected Value	Maximum Detected Value	Average Detected Value	Coefficient of Variation	Screening Level (SL)	Quantity Exceeding 1X the SL	Quantity Exceeding 10X the SL	Quantity Exceeding 100X the SL
Antimony	2	1	0.3	0.3	0.3	< 0.001	2.92	0	0	0
Arsenic	2	1	0.42	0.42	0.42	< 0.001	150	0	0	0
Cadmium	93	80	0.4	3.7	0.736	0.53	0.38	80	0	0
Copper	5	2	0.84	2	1.42	0.58	3.2	0	0	0
Iron	6	2	10	250	130	1.31	1,000	0	0	0
Lead	90	46	0.001	80	3.97	2.9	1.09	34	1	0
Manganese	6	5	1	130	30.3	1.84	20.4	1	0	0
Zinc	93	93	0.101	340	121	0.4	42	90	0	0

ATTACHMENT 4
Screening Levels

SCREENING LEVELS

Based on the results of the human health and ecological risk assessments, 10 chemicals of potential concern (COPCs) were identified for inclusion and evaluation in the RI. The COPCs and appropriate corresponding media (soil, sediment, groundwater, and surface water) are summarized in Table 1. For each of the COPCs listed in Table 1, a screening level was selected.

The screening levels were used in the RI to help identify source areas and media of concern that would be carried forward for evaluation in the feasibility study (FS). The following paragraphs discuss the rationale for the selection of the screening levels.

Applicable risk-based screening levels and background concentrations were compiled from available federal numeric criteria (e.g., National Ambient Water Quality Criteria), regional preliminary remediation goals (PRGs) (e.g., EPA Region IX PRGs), regional background studies for soil, sediment, and surface water, and other guidance documents (e.g., National Oceanographic and Atmospheric Administration freshwater sediment screening values). Selected RI screening levels are listed in Tables 2 through 4.

For the evaluation of site soil, sediment, groundwater, and surface water chemical data, the lowest available risk-based screening level for each media was selected as the screening level. If the lowest risk-based screening level was lower than the available background concentration, the background concentration was selected as the screening level.

Groundwater data are screened against surface water screening levels to evaluate the potential for impacts to surface water from groundwater discharge.

For site groundwater and surface water, total and dissolved metals data are evaluated separately. Risk-based screening levels for protection of human health (consumption of water) are based on total metals results, therefore, total metals data for site groundwater and surface water were evaluated against screening levels selected from human health risk-based screening levels. Risk-based screening levels for protection of aquatic life are based on dissolved metals results, therefore, dissolved metals data for site groundwater and surface water were evaluated against screening levels selected from aquatic life risk-based screening levels.

Table 1
Chemicals of Potential Concern

Chemical	Human Health COPC			Ecological COPC		
	Soil/Sediment	Groundwater	Surface Water	Soil	Sediment	Surface Water
Antimony	X	X				
Arsenic	X	X	X	X	X	
Cadmium	X	X	X	X	X	X
Copper				X	X	X
Iron	X					
Lead	X	X	X	X	X	X
Manganese	X		X			
Mercury			X		X	
Silver					X	
Zinc	X	X	X	X	X	X

Table 2
Selected Screening Levels for Groundwater and Surface Water—Coeur d'Alene River Basin and Coeur d'Alene Lake

Chemical	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Groundwater Total (µg/L)	Groundwater Dissolved (µg/L)
Antimony	6[a]	2.92[b]	6[a]	2.92[b]
Arsenic	50[a]	150[c,d]	50[a]	150[c,d]
Cadmium	2[e]	0.38[b]	2[e]	0.38[b]
Copper	1[e]	3.2[c,d]	1[e]	3.2[c,d]
Iron	300[a]	1,000[c,d]	300[a]	1,000[c,d]
Lead	15[a]	1.09[b]	15[a]	1.09[b]
Manganese	50[a]	20.4[b]	50[a]	20.4[b]
Mercury	2[a]	0.77[c,d]	2[a]	0.77[c,d]
Silver	100[a]	0.43[c,d]	100[a]	0.43[c,d]
Zinc	30[e]	42[c,d]	30[e]	42[c,d]

[a]40 CFR 141 and 143. National Primary and Secondary Drinking Water Regulations. U.S. EPA Office of Water. Office of Groundwater and Drinking Water. http://www.epa.gov/OGWDW/wot/appa.html. October 18, 1999.
[b]Dissolved surface water 95th percentile background concentrations calculated from URS project database.
[c]Freshwater NAWQC for protection of aquatic life are expressed in terms of the dissolved metal in the water column.
[d]Freshwater NAWQC for cadmium, copper, lead, silver, and zinc are expressed as a function of hardness (mg/L of CaCO3) in the water column.
Values above correspond to a hardness value of 30 mg/L.
[e]Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of
Energy. Office of Environmental Management. ES/ER/TM-96/R2. Value based on total metals concentration.

Note:
µg/L - microgram per liter

Table 3
Selected Screening Levels for Surface Water—Spokane River Basin

Chemical	SpokaneRSeg01		SpokaneRSeg02		SpokaneRSeg03	
	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)	Surface Water Total (µg/L)	Surface Water Dissolved (µg/L)
Antimony	6[a]	2.92[b]	6[a]	2.92[b]	6[a]	2.92[b]
Arsenic	50[a]	150[c]	50[a]	150[c]	50[a]	150[c]
Cadmium	2[e]	0.38[b]	2[e]	0.38[b]	2[e]	0.38[b]
Copper	1[e]	2.3[c,d]	1[e]	3.8[c,d]	1[e]	5.7[c,d]
Iron	300[a]	1,000[c]	300[a]	1,000[c]	300[a]	1,000[c]
Lead	15[a]	1.09[b]	15[a]	1.09[b]	15[a]	1.4[c,d]
Manganese	50[a]	20.4[b]	50[a]	20.4[b]	50[a]	20.4[b]
Mercury	2[a]	0.77[c]	2[a]	0.77[c]	2[a]	0.77[c]
Silver	100[a]	0.22[c,d]	100[a]	0.62[c,d]	100[a]	1.4[c,d]
Zinc	30[e]	30[c,d]	30[e]	50[c,d]	30[e]	75[c,d]

[a]40 CFR 141 and 143. National Primary and Secondary Drinking Water Regulations. U.S. EPA Office of Water. Office of Groundwater and Drinking Water. http://www.epa.gov/OGWDW/wot/appa.html. October 18, 1999.
[b]Dissolved surface water 95th percentile background concentrations calculated from URS project database. Technical Memorandum. Estimation of Background Concentration in Soils, Sediments, and Surface Waters. Coeur d'Alene Basin RI/FS. URS. May 2001.
[c]Freshwater NAWQC for protection of aquatic life are expressed in terms of the dissolved metal in the water column.
[d]Freshwater NAWQC for cadmium, copper, lead, silver, and zinc are expressed as a function of hardness (mg/L of CaCO3) in the water column.
[e]Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of Energy. Office of Environmental Management. ES/ER/TM-96/R2. Value based on total metals concentration.

Note:
µg/L - microgram per liter

Table 4
Selected Screening Levels—Soil and Sediment

Chemical	Upper Coeur d'Alene River Basin		Lower Coeur d'Alene River Basin		Spokane River Basin	
	Soil (mg/kg)	Sediment (mg/kg)	Soil (mg/kg)	Sediment (mg/kg)	Soil (mg/kg)	Sediment (mg/kg)
Antimony	31.3[a]	3.30[b]	31.3[a]	3[c]	31.3[a]	3[c]
Arsenic	22[b]	13.6[b]	12.6[b]	12.6[b]	9.34[b]	9.34[b]
Cadmium	9.8[d]	1.56[b]	9.8[d]	0.678[b]	9.8[d]	0.72[b]
Copper	100[d]	32.3[b]	100[d]	28[c]	100[d]	28[c]
Iron	65,000[b]	40,000[c]	27,600[b]	40,000[c]	25,000[b]	40,000[c]
Lead	171[b]	51.5[b]	47.3[b]	47.3[b]	14.9[b]	14.9[b]
Manganese	3,597[b]	1,210[b]	1,760[a]	630[c]	1,760[a]	663[b]
Mercury	23.5[a]	0.179[b]	23.5[a]	0.179[b]	23.5[a]	0.174[c]
Silver	391[a]	4.5[c]	391[a]	4.5[c]	391[a]	4.5[c]
Zinc	280[b]	200[b]	97.1[b]	97.1[b]	66.4[b]	66.4[b]

[a]U.S. EPA Region IX Preliminary Remediation Goals for Residential or Industrial Soil http://www.epa.gov/region09/wasate/sfund/prg. February 3, 2000.
[b]Technical Memorandum. Estimation of Background Concentration in Soils, Sediments, and Surface Waters. Coeur d'Alene Basin RI/FS. URS. May 2001.
[c]Values as presented in National Oceanographic and Atmospheric Administration Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA. M. F. Buchman, 1999. Values generated from numerous reference documents.
[d]Final Ecological Risk Assessment. Coeur d'Alene Basin RI/FS. Prepared by CH2M HILL/URS for EPA Region 10. May 18, 2001. Values are the lowest of the NOAEL-based PRGs for terrestrial biota (Table ES-3).

Note:
mg/kg - milligram per kilogram

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REMEDIAL INVESTIGATION REPORT

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